Railway Mechanical Engineer

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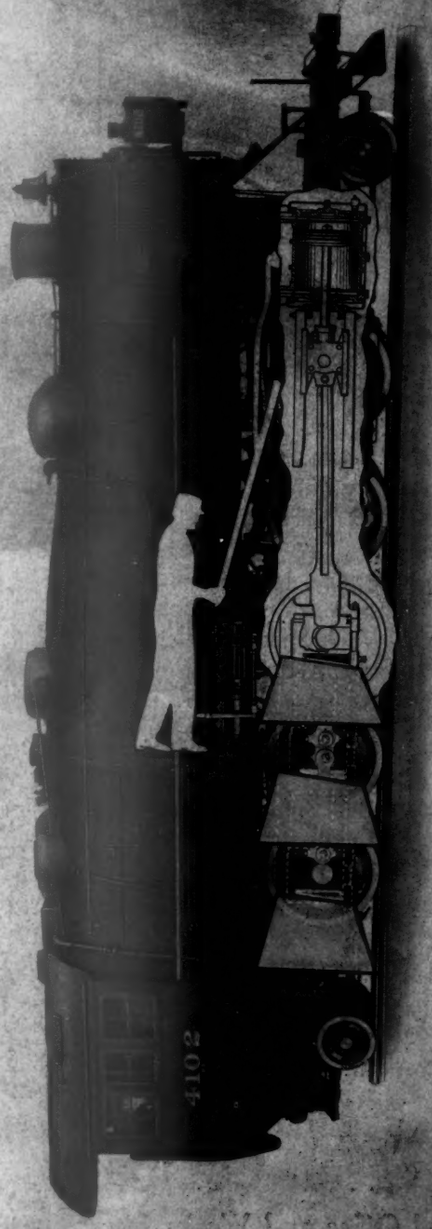

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Buyers' Index, Page 182

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Railway Mechanical Engineer

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The High Cost of Publishing

In 1832 when the American Railroad Journal, the forerunner of the *Railway Mechanical Engineer,* was founded the subscription price was three dollars a year. In 1837 the journal was changed to a weekly and the price was increased to five dollars. Probably none of our readers remember when the change in the subscription price to two dollars went into effect. For many years this has remained unchanged; but recent increases in the cost of both labor and materials have been so great that the publishers are now forced to increase the subscription price to three dollars in the United States, east of the Mississippi and in Mexico and four dollars west of the Mississippi, in Canada and foreign countries. The increase in the subscription price beyond the Mississippi is due to discrimination against that section of the country embodied in an Act of the Congress which provides for geographical zone rates and progressive increases. The publishers regret this; but the action of the government leaves no alternative.

To some of our readers it may come as a surprise to learn that even the new subscription price will not pay the cost of the paper alone. The price of this one item has increased over 200 per cent and the end does not seem in sight. The increases in the cost of material and labor are matters which are probably of minor interest to our readers, however, and are mentioned only to avoid the charge of profiteering. The editors realize that the subscribers are most concerned with the way in which the publication covers its field. It will be our endeavor to make the *Railway Mechanical Engineer* worth all that it costs to our readers and the editors will welcome suggestions for improvement that will make it more valuable to railroad men.

The Importance of the Foreman

In the past many railroads have been open to criticism because of their failure to accord to men in the minor supervisory positions either the compensation or the recognition to which they were entitled. The status of the foremen in the mechanical department has been improved during the past two years. It is to be hoped that conditions will continue to grow better and that a real incentive will be created so that the most competent and ambitious workers will be induced to strive for promotion and to make the most of their opportunities for further advancement. The lack of personal interest on the part of the higher officers is often responsible for a feeling of indifference among the foremen, which has a decidedly bad effect on the men under them. In this connection Dr. Hollis Godfrey recently said: "The one man most vitally affecting the workman is the foreman. When industry adopts education, when it teaches its management and its foremen to teach, it will eliminate many of the major causes of labor trouble. This will be done not merely through the development of the good fellowship that is inevitable. It will follow as a natural result of giving every man a real chance. When the foreman is taught by his industry and in turn becomes a teacher of the men under his orders, obstacles to each man's rise will be removed. Every man will have the same chance to progress. Nothing makes more difference in industrial unrest than the foreman; nothing can serve better to help industry and the workman than to make him a teacher."

Under present conditions the majority of general officers are burdened with a mass of detail which should be handled by their subordinates. The foremen, instead of being minor executives, are little more than clerks. This condition should not exist if the higher officers would accept Doctor Godfrey's

suggestion. Instead of throwing the foreman on his own resources, giving him little authority and expecting little of him, the roads should take steps to develop the foreman's executive ability, teach him how to handle men and outline the general policy which he should follow. With such training the foreman could be given more authority, more questions could be settled locally and the higher officers would be relieved of a large proportion of the detail work with which they are now burdened.

Bronze and Babbitt Bearings

In an article on bronze and babbitt bearings appearing in this issue, the author, who is a manufacturer of bearings, has aptly referred to the scrap pile as the laboratory of experience and has commented on the lack of suitable bearing testing machines. If it is a fact that the value of such testing machines as we now have lies mainly in the testing of the lubricant, the design of a practical machine for testing the physical properties of journal bearings would appear to offer an excellent field for further development. The statement that the application of a single formula may result in a large variation in the structure of the bearings caused by different pouring temperatures or rates of cooling, and that consequently analysis is a faulty basis on which to purchase bearings, may lead to some discussion among our readers. It is also stated that conservation of tin during the war caused the United States Railroad Administration to specify high-lead bearings for the new cars purchased and as this resulted in an unusually soft bearing there is some question as to how soon these bearings will require replacement. Now that the cars to which these bearings were applied have been in operation some time it would be interesting to know what results are being obtained from these bearings in actual service.

The Service of Supply

Lack of material with which to complete repairs to equipment held in shops is perhaps the most frequent complaint heard from foremen and shop superintendents; it is also one of the best excuses ever offered for not getting the power out in time to suit the operating department. It would be difficult to make a comparison between railroad and industrial shops without observing an unsatisfactory condition on the railroad, with respect to material supply, that cannot altogether be accounted for by the greater diversity of work encountered on the railroad. This view, however, does not take into consideration the fact that on any railroad the shops include many small units scattered over a wide territory as contrasted with industrial enterprises, which are generally concentrated within a single shop or group of buildings thus making it possible to provide at all times an adequate supply of material without accumulating an excessive stock. The shop foreman does not always appreciate just how expensive it is to maintain a stock of material that would be large enough to meet any possible requirement. In the eyes of the shop, every delay to important work on account of a shortage of material tends to overshadow any possible benefit obtained through carrying the smallest possible stock of all materials.

On the other hand it is possible for the stores department to overlook the loss that may be occasioned if material is not always on hand when it is needed. The general storekeeper or purchasing agent can usually carry his point with the management because he is able to produce a convincing statement showing the amount of money that can be saved by means of a reduction in material stocks, but it is next to impossible for the shop superintendent to prove in dollars and cents just what loss has been occasioned by equipment held in the shop waiting for material or to demonstrate what could actually be saved through increasing certain quantities of material carried in stock.

This is a situation which admits of further study on the part of the railroads with a view to striking a proper balance between the objectives of the mechanical and the stores departments. A better mutual understanding of the problems of both departments with respect to the service of supply would be helpful.

Overcoming Rising Costs

For many years preceding the war the development of the locomotive may be said to have kept ahead of the times. The war brought locomotive development practically to a standstill, while it increased the cost of everything entering into locomotive construction, maintenance and operation. The result is obvious. Locomotives are paying about one-half the dividends they did before the war; in other words, the cost of tractive effort has been doubled. These costs are not coming down and the railroad security holder will not be satisfied with a lower return. The efficiency of the locomotive must and will be increased to meet the situation.

For years the Germans applied feedwater heaters, while French and English locomotives were somewhat of a curiosity to us because of their light reciprocating parts. More recently pulverized coal has been used on Brazilian locomotives. In pre-war years the American locomotive development was so rapid that the railroads were satisfied to "let well enough alone" and ignored the refinements introduced abroad because costs, particularly fuel cost, were so much lower in this country. Now that cheap coal is a thing of the past there can be no argument against the feedwater heater, lighter reciprocating parts and the use of inferior coals in pulverized form.

Will the railroads utilize the 15 to 20 per cent saving resulting from the use of a feedwater heater and take advantage of alloy steels, not only to reduce dynamic augment but to lighten the weight of reciprocating parts so that boiler capacity can be increased? Will they take the initiative in the development of the use of pulverized coal as a means of utilizing anthracite culm and Dakota lignite? Or will the railroads continue to view these developments from a critical standpoint? Is is easy to say that the feedwater heater will add to maintenance, that alloy steels increase the first cost of the locomotive and that pulverized coal is entirely a development for the future, but it is imperative that mechanical men make these developments a success rather than an obstruction. The motive power department has a better opportunity today than ever before to improve locomotive efficiency.

Wet Steam Decreases Efficiency

In large modern locomotives the boiler often extends up nearly to the limit of the road clearance and the height of the steam dome is greatly restricted. This in turn necessitates placing the throttle valve relatively close to the normal water level in the boiler, and as a result there is a tendency for water to be entrained in the steam at high rates of evaporation or when the water is carried too high. This carying over of water takes place even with the best water supply and is of course aggravated when the water carries impurities that cause foaming or priming. Tests made under both laboratory and road conditions have shown that the steam entering the dry pipe may have as high as four to six per cent of moisture.

If moisture is carried over with the steam the superheater must evaporate the entrained moisture and the superheat is therefore reduced. The amount of heat required to evaporate water is relatively high when compared with the heat

needed to superheat steam; therefore even a small percentage of moisture will cause a serious reduction in the superheat. To convert one pound of water at 200 lb. pressure into steam requires 838 B.t.u., but only 60 B.t.u. are needed to superheat the steam 100 deg. F. Therefore, an increase of five per cent in the moisture content will cause a decrease of 70 deg. in the superheat, assuming that the rate of heat transfer through the tubes is unchanged. If evaporation takes place in the superheater to any considerable extent the unit tubes become lined with scale, thus reducing the rate of heat transfer and cutting down the superheat under all conditions. The serious results of a high moisture content in the steam can be realized from the fact that a falling off in the superheat from 250 deg. to 180 deg. (equivalent to an increase of five per cent in the moisture in the steam) raises the coal consumed about 15 per cent. In other words, each increase of one per cent in the moisture content of the steam will cause a three per cent increase in the fuel consumption.

The loss of efficiency resulting from the entraining of moisture is so serious that the problem of overcoming this trouble deserves careful study. If the dome does not extend up to the clearance limits, the quality of the steam may be improved by making it higher and raising the inlet to the throttle. Locating the dome some distance ahead of the rear tube sheet should be an advantage as the ebulition is least rapid over the forward part of the tubes. Throttle valves which draw steam only from the extreme upper part of the stand pipe are also advantageous. If with the best arrangement of dome and throttle that can be devised the moisture content of the steam is still high, a steam separator may be needed. Plans are now under way for the installation of a steam separator and its effect on the quality of steam will be watched with interest. The fact that an increase of one per cent moisture in the steam will cause an increase of three per cent in fuel consumption is of sufficient importance to warrant the most serious consideration of this problem.

What Do You Think?

In what way do you believe that locomotive efficiency and capacity can be most effectively increased? In this issue Mr. Milner has suggested three or four ways in which he thinks this can be done. If you don't agree with him or can suggest a better means, the *Railway Mechanical Engineer* would like to know your views.

The article on new electric passenger locomotives for the St. Paul indicates very clearly that electrical engineers have not come to any agreement on the best type for passenger service on mountain grades. If you are keeping in touch with electrical matters, as you should, you may be able to give us your own idea as to the best type.

Determining the proper loads for locomotives is a live topic. Mr. Mounce's article will add something to your knowledge of this subject, and if you have a theory on train loading, now is the time to put it into an article.

Freight car repair methods vary the country over. This issue describes in a very complete article how the work is done on the E. P. & S. W. If you cannot tell us how you are repairing cars on your railroad, perhaps you can send the *Railway Mechanical Engineer* some good pictures and a few notes that will tell the story.

In the Shop Practice Section the article on measurement records outlines a method that might be useful in your shop. What do you think about it?

The New Devices Section should not be overlooked if you want to keep up to date.

The *Railway Mechanical Engineer* solicits cooperation on the part of its readers; don't be satisfied with subscribing but contribute something.

NEW BOOKS

The Condensed Chemical Dictionary. 523 pages, 6 in. by 9 in., bound in cloth. Published by the Chemical Catalog Company, 1 Madison avenue, New York.

In the shipment of chemical products, railroads are often confronted with the perplexing problem of determining whether the nature of the chemical makes its transportation hazardous. Realizing the need for a work that would give in a condensed non-technical form information regarding the properties of chemicals, the publishers have compiled this reference work. In addition to a concise statement of the physical and chemical properties commonly included in more voluminous works, there is stated for each substance the type of container used, the fire hazard and the railroad shipping regulations. While the book will be found particularly useful for those who desire data in a non-technical form, it should also prove a handy reference work for chemists.

Mechanical World Year Book for 1920. 328 pages, 4 in. by 6 in., illustrated, bound in cloth. Published by Emmott & Co., Ltd., 65 King street, Manchester, England.

This is the latest edition of an English reference book that has been in publication for 33 years. The current edition is an enlargement over previous issues and contains several new features, including an important section dealing with water and hydraulic work in which information is given on the friction of water in pipes and on pumps and pump fittings. The applications of hydraulic power are described and data given on hydraulic accumulators, hydraulic press cylinders, flanging presses, punching presses, hydraulic pipes and flanges. Another addition is a section on heating and evaporating liquids. This includes descriptions of tubular heaters, feedwater heaters and evaporators. The book is quite complete with respect to gas and oil engines, particularly the Diesel engines.

Inventions, Their Purchase and Sale. By William E. Baff, 230 pages, 5 in. by 7½ in., bound in cloth. Published by D. Van Nostrand, New York.

This book is written by a patent attorney who is familiar with the steps by which many inventors have turned their patents to good account and contains many commonsense suggestions on how to make the most out of an invention after the patent has been obtained. It is essentially a business man's book on the marketing of inventions and does not deal directly with inventions in their inception and handling through the patent office, but rather with the methods of obtaining the greatest return.

Invention has played an important part in railroad development and patents developed in railway practice are usually taken in hand by some carrier for the privilege of using the device if it proves successful in operation. If the inventor obtains a broad patent upon a meritorious device he is usually successful in placing it in the hands of an established supply house and does not find it necessary to engage in the business of marketing his invention in order to realize a profit from it. However, no inventor can afford to overlook the business viewpoint. No matter how ingenious his invention may be, it must be something upon which business men can make a profit. This book will recommend itself to any inventor who is anxious to know what is required of a patent to make it successful from a commercial as well as a mechanical standpoint.

COMMUNICATIONS

ABUSE OF SAFETY APPLIANCES

Cincinnati, Ohio.

To the Editor:

There has been a great deal said and written about the inspection and maintenance of safety appliances, but there is very little said about the abuse of them. This abuse is principally due to rough handling or carelessness on the part of trainmen. It is a common occurrence to find several cars on repair tracks daily with ends broken out, causing loose side and end grab irons, or bent and inoperative brake staffs, or uncoupling levers.

Often couplers are pulled out of cars, which are then switched from one track to another, damaging the safety appliances on every car they come in contact with, which could be avoided if the cars were properly disposed of after being damaged.

Safety appliances were made for the protection of trainmen, but as a rule they receive very little consideration, as these employees apparently have little respect for safety appliances or any other part of a freight car. E. F. C.

THE MECHANICS' VIEWPOINT

Meadville, Pa.

To the Editor:

A workman is a funny animal, and to handle him requires tact, diplomacy and a working knowledge of human nature; like a mule he can be led but not driven, and a little appreciation goes a long way to help the monotony of his daily grind, for such it gets to be. Never lose sight of the fact that a man is attracted to the particular work he chooses more by inclination than by circumstances. He follows a bent, a leaning. The way to get the best from him is to *keep him interested.*

This can be done in various ways — by showing a little interest in him and his work, by indirect suggestion, by creating a little friendly rivalry, by an efficient first-aid chest, by fair compensation and by real appreciation. Some men handle their workmen on the theory that they will be impressed and produce more if they, the big men, keep away—hold themselves aloof. Get acquainted with your men, place them to the best advantage, take a healthy interest in their work and the little troubles they have with their jobs and machines, and you will get results.

The last hundred years have shown more advancement than all the years gone before. To be up to date requires more application and study as the times progress; the day of the all-around man has given way to the specialist. The field has broadened to such an extent that he who covers it all knows very little of any one thing, and is constantly running afoul of unseen situations that are easy to foresee and be met by the one on the ground, so to speak. Knowledge commands respect in the shop as in other walks of life, and is a result-getter—one of the best, one that will endure.

You would be surprised if I told you I never saw a man on any kind of a job that was not pleased at the prospect of increased production through the medium of better tools, improved methods, or short cuts. It is a fact, and instead of holding down the output, as he is sometimes accused, he really hopes in some way, not always clear to him perhaps, to increase his daily average; when he does, a little hearty interest repays him and spurs him to greater efforts.

One of the hardest things for man today is to be broad-minded, to look without prejudice at the two sides of a question. Some reasons that make it harder are knowledge of only one side of the question, not being interested in two sides, dwelling on theories at the expense of the practical, aloofness and selfishness.

When the big man comes late to work fresh from his daily bath, things naturally look different to him. He goes about his side of it left handed; his comfortable ideas of his own greatness make it hard for him to come down to common everyday problems and explains the breach between him and his men. If the average big man was to obtain the private opinion of his men he would be surprised; he would find the workman's ability to absorb punishment had in no way dulled his sensibilities and the high standard of living of the American worker puts him in a class alone; he must be considered and handled differently than alien labor.

Never advocate piecework as it is the surest way to get indifferent quality and, of course, larger quantity, as quantity is all the pieceworker can see; it is hard on the nerves of the nation and in due time will show its effects. There are other ways to get results, and the dawn is open for them.

From a Railroad Mechanic.

[This letter was not written for publication, but is taken from a personal letter to one of the members of our staff. It is so much to the point that we felt it would be of interest and help to many of our readers in directing the efforts of the men under them.—Editor.]

LUBRICATION OF CYLINDERS

Chicago, Ill.

To the Editor:

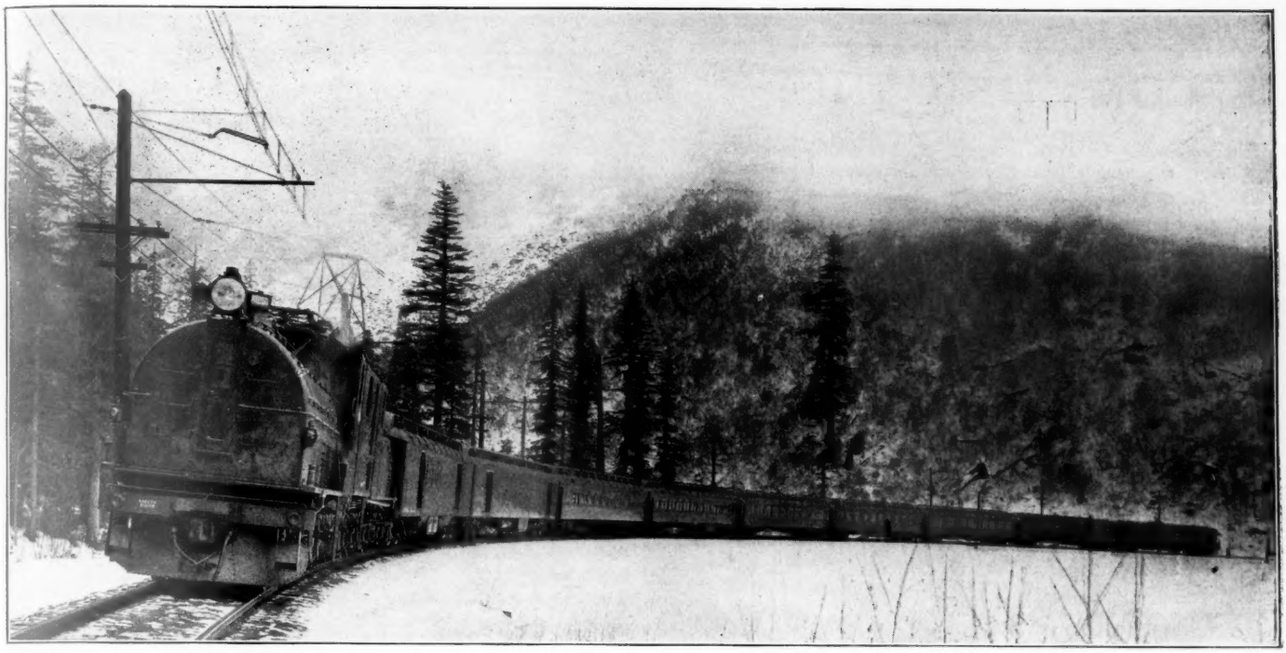
In your editorial on "Lubrication of Cylinders," in the March issue, you call attention to the various points at which the oil is injected, but say nothing about the manner of delivery. It stands to reason that with the gravity lubricator, the lower the point at which the oil is injected into the steam the more regular the delivery will be. Connecting the gravity feed lubricator pipe to the cylinder instead of in the steam pipe has the additional advantage of delivering the oil into steam of less pressure. These two factors, the greater pressure head and the reduced resistance pressure, should tend toward an improved cylinder lubrication, provided carbon incrustation can be avoided.

I cannot, however, see how the valve lubrication would be improved, since it is conceded by those who advocate gravity lubricators feeding into the cylinder only, that the live steam valve rings would have to depend for lubrication on the oil that is carried by the exhaust rings of the valve to that part of the valve chamber wall traveled by the live steam rings.

You also state that there is a growing tendency to dispense with swabs on piston rods. The reason you give, however, is not the whole cause. The principal reason is that the rod packing cannot pack against a thin film of oil so that with pressure inside the cylinder and no pressure outside, enough oil impregnated steam leaks by the packing to lubricate the rod.

If the above holds true we should not expect good lubrication of the live steam valve rings, because the conditions are just the reverse of rod lubrication. In the rod lubrication the pressure side carries the oil to the non-pressure side, which is natural, while with the valve lubrication we should not expect the lower exhaust pressure side to carry and maintain the oil in the higher live steam pressure side.

It seems reasonable, therefore, to lubricate the live steam side of the valve first, by injecting the oil into the steam pipe about 20 in. above the valve, and with the same oil impregnated steam, lubricate the cylinder and, again, as an extra precaution that does not cost anything, use that same oil impregnated steam to lubricate the exhaust side of the valve. It is absolutely necessary, to realize the best results from the scheme above outlined, to inject the oil into the steam at every revolution of the drivers, as can be done with a force feed lubricator. W. J. Schlacks.



St. Paul Passenger with General Electric Locomotive

NEW ELECTRIC LOCOMOTIVES FOR THE C. M. & ST. P

Description of Two Radically Different Types Recently Designed for Passenger Service

FIFTEEN additional electric passenger locomotives are now being constructed for the electrified divisions of the Chicago, Milwaukee & St. Paul. Five of these are being built by the General Electric Company and ten by the Westinghouse Electric & Manufacturing Company in conjunction with the Baldwin Locomotive Works.

The motive power equipment for the initial electrified division of 440 miles over the Rocky Mountains consisted of 32 freight locomotives, 10 passenger locomotives and 4 switching locomotives. When it was decided to electrify the division over the Cascade Mountains these 15 new passenger locomotives were ordered. The original 10 passenger locomotives will be regeared for freight service, so that the St. Paul will now have 15 passenger, 42 freight and 4 switchers, or a total of 61 electric locomotives in service on the two electrified divisions.

The two new types of electric passenger locomotives built for the Chicago, Milwaukee & St. Paul were designed for the same class of service by different groups of engineers working independently; from an inspection of the finished locomotives it would appear that the two types could hardly be more different.

Roughly the requirements for both designs were as follows: The locomotives must collect 3,000 volt direct current power from an overhead catenary. They must be able to haul a 12-car passenger train weighing 950 tons over a two per cent grade, compensated for a distance of 20 miles, and over a 2.2 per cent grade compensated for a distance of 17.8 miles. They must maintain speeds of approximately 25 miles an hour up two per cent grades, 35 miles an hour up one per cent grades, 60 miles an hour on level tangent track and must hold trains on down grades by regenerative braking at speeds consistent with safe operation. The sharpest curve on the main line is 10 deg., but the specifications required that the locomotives must negotiate a 16-deg. curve in the yards satisfactorily.

The General Electric Locomotive

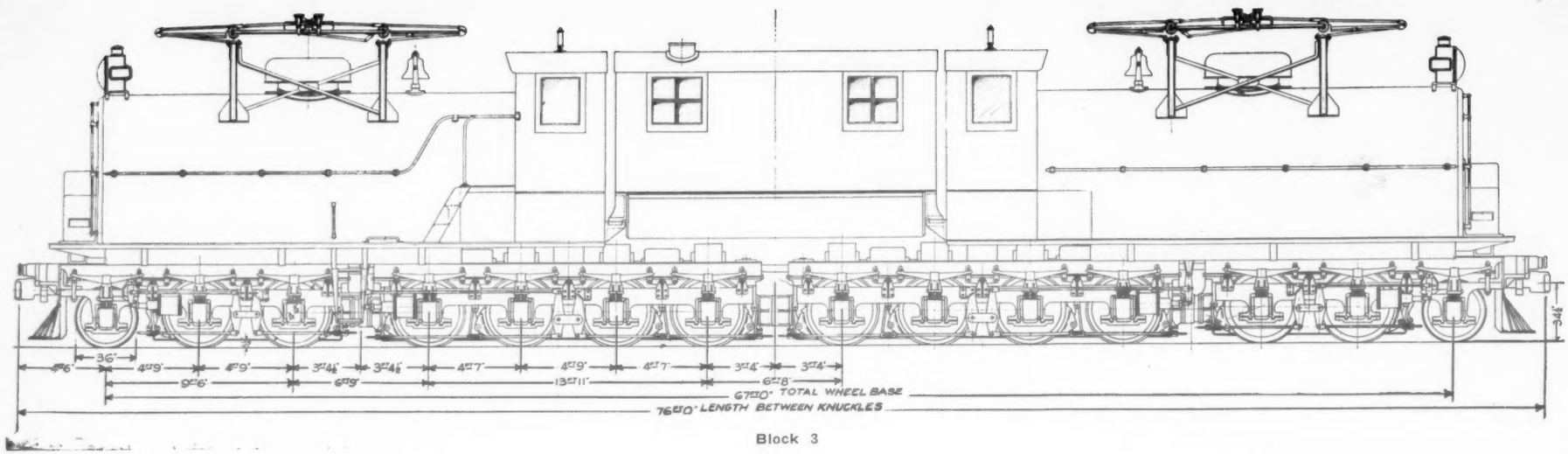
The running gear of the General Electric locomotive is composed of four individual trucks, two end trucks having three axles each, and two center trucks having four axles each. These trucks are connected together by special articulation joints. The motor armatures are mounted on the axles and the motor fields are carried on the truck frames.

The two end sections are similar to each other in appearance. The operator's cab in either section is on the inner end next to the heater cab above described, in order that the operator can be convenient to the heater and in order to allow a maximum space for apparatus in the apparatus cab or outer end section. Another advantage of this arrangement of cabs is that the operator can have access to any section of the locomotive requiring his presence without passing through a section containing high-tension apparatus. The engineer's or operating cab contains a main or master controller, the air brake valves and handles, and an instrument panel, containing air gages, ammeters, and speed indicator. The engineer uses either of the two operating cabs according to the direction in which he is running.

A door gives access from the operating cab to the apparatus section which extends with a cylindrical top to the extreme end of the locomotive. The cylindrical construction naturally adapts itself to the protection of the apparatus included and in addition to this it has the advantage of allowing a clear vision for the operator from his normal operating position.

Motors

The motors are of the bi-polar gearless design which were adopted by the New York Central 14 years ago for operating



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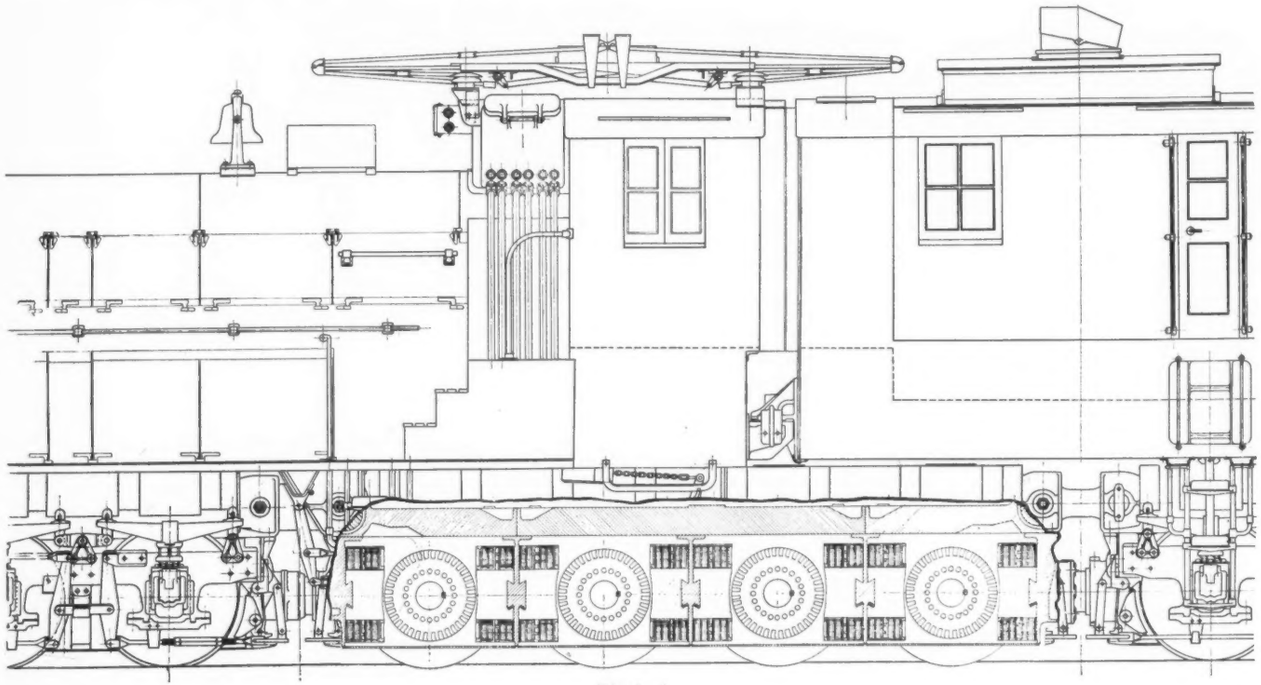

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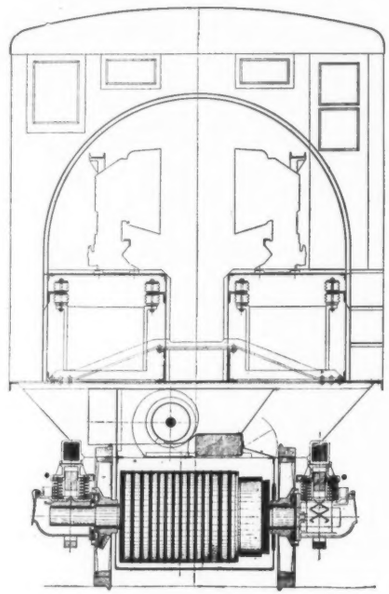


Block 2

Side Elevation and Section of General Electric Locomotive, Showing Wheel Arrangement and L ocation of Motors

heavy passenger trains between Grand Central Station and Harmon, N. Y. To insure light weight per axle, flexibility in control, good truck arrangement for curving as well as for high-speed running, twelve motors are chosen, each of relatively small capacity. They are especially designed to withstand high temperature, being insulated with mica and asbestos. The continuous rating of each motor at 1,000 volts and with 120 deg. rise by resistance is 266 hp., corresponding to 3,500 tractive effort at the rim of the drivers at a speed of 28.4 mi. per hr. Forced ventilation is employed for cooling. The armature core is provided with holes for the passage of ventilating air. Ventilating blowers are located above each motor armature and deliver air at the commutator end of the motor where it divides, a part passing through the armature and a part back through and around the field coils where it escapes upwards and is afterwards used for ventilating the starting resistors.

This type of motor lends itself nicely to simple and compact locomotive design as the frame is made use of to furnish the entire path for the magnetic flux. The pole pieces and field coils are fastened to the cross transoms of the trucks and the magnetic flux passes horizontally in series through all twelve motors, finding a return path through the locomotive frame. The articulation joints between the trucks are made in such a manner that large surfaces are in contact to provide an easy path for the flux. The pole pieces are made flat in order to prevent the pole pieces from coming in contact with the armature during the vertical movement of the truck frame on its springs or when removing or assembling the armatures. A minimum clearance of ⅛-in. on each side is allowed between the armature and the pole piece tips. The brushholders are bolted to the transom allowing the brushes to move up and down with the fields as the frame rides on the truck springs.

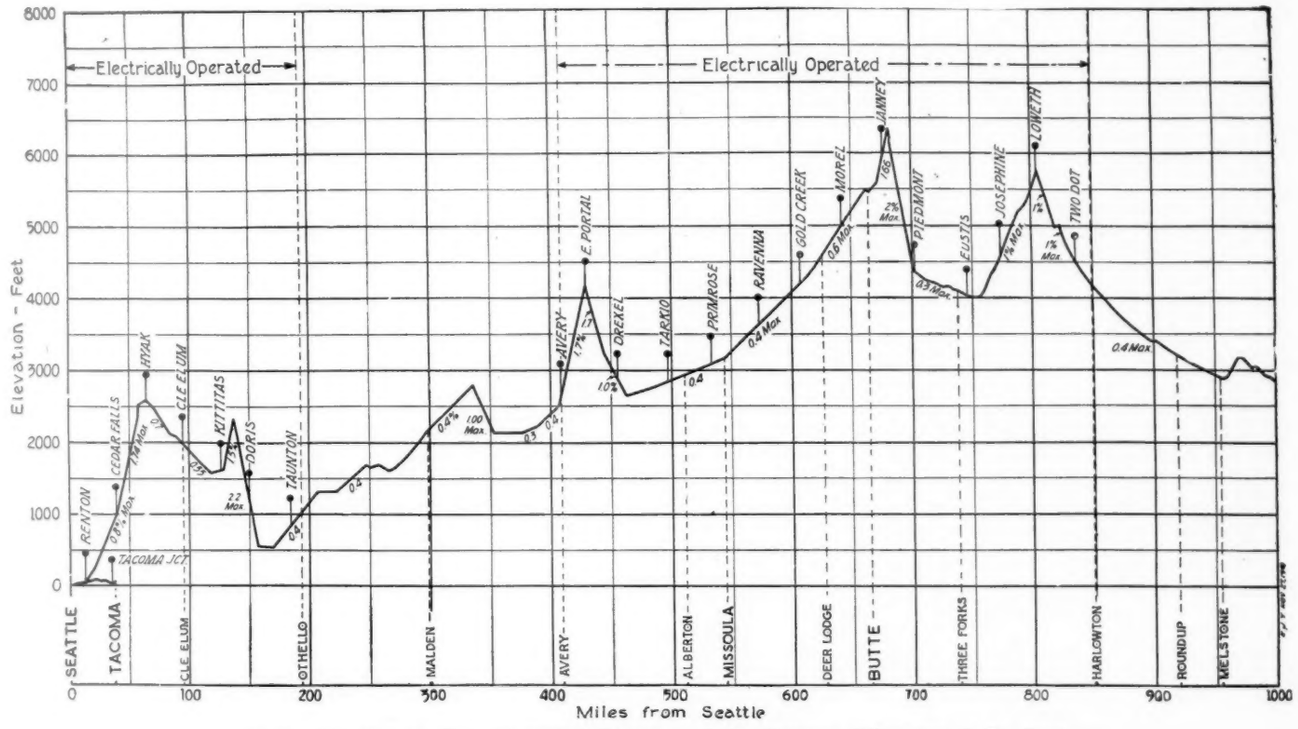
Control

The control for motoring is arranged for four motor combinations. The first combination has nine rheostatic steps, one full field step, and one tapped field step, with twelve motors in series across 3,000 volts. The second combination has six rheostatic steps, one full field step, and one tapped field step, with six motors in series and two sets in multiple. The third combination has eight rheostatic steps, one full field step, and one tapped field step, with four motors in series, and three sets in multiple. The fourth combination has eight rheostatic steps, one full field step, and one tapped field step, with three motors in series, and four sets in multiple. This results in a total of 39 control steps with a choice of eight operating speeds, exclusive of the resistance steps.

The regeneration of power for braking is accomplished by using some of the motors for exciting the fields of the others, which in turn are used as generators to return power to the line.

Auxiliary Apparatus

The center cab is occupied by an oil-fired steam boiler for heating passenger trains and with accessories, including tanks for oil and water, circulating pumps, and a motor-driven blower for furnishing forced draft. This center portion of the cab may be lifted out in case the steam boiler is in need of heavy repairs.



Profile Showing the Two Electrified Divisions of the Chicago, Milwaukee & St. Paul

Power for train lighting is obtained from the motor-generator set. A switchboard located in the operator's section of one of the cabs is equipped with switches, resistors and meters for controlling the train lighting circuit. The head end system of lighting is in use on the trains over this division. In the other operating cab is a small motor-driven air compressor, operated from the battery circuit, with sufficient capacity for raising the pantograph when first putting the locomotive in operation.

A slider pantograph, similar in construction to those now in use, is mounted on each of the operating cabs. This pantograph has two sliding contacts, giving a total of four on the slider with a double trolley. The pantograph and flexible twin trolley construction enable the locomotive to collect current as high as 2,000 amperes at speeds up to 60 miles an hour without noticeable arcing at the contact points. The second pantograph is held in reserve as a spare. Sand boxes,

Side Elevation and Section of General Electric Locomotive, Showing Wheel Arrangement and Location of Motors

with pipes leading to each pair of driving wheels, are located directly beneath the pantographs outside of the operating cab.

Mechanical Construction

To soften any lateral blow that may be given against the rail head, the leading and trailing axles are allowed a movement of one-half inch relative to the truck frame, either way from their central position. This movement takes place against a resistance introduced by wedges above the journal boxes which tend to hold the box in its central position and to give a dead beat action opposing the motion. To further protect the track from lateral displacement on the ties, the outer end of the superstructure is carried on rollers, bearing on inclined planes upon the truck frames, while the inner end of the superstructure is rigidly bolted to one of the middle trucks. This construction tends to hold the leading and trailing trucks in their central position.

View from Engineer's Position on General Electric Locomotive

When a blow is delivered by the leading or trailing truck against the rail head, the superstructure, which is rigidly bolted to the middle truck, is displaced laterally across the outer truck very much as a boiler of a Mallet locomotive swings across its leading truck. In such a sideways displacement, the weight of the superstructure rolls up on the inclined plane on that side and thus transfers weight to the rail that is affected, thereby increasing the adhesion of the rail to the tie. This action really has two results. It not only increases the holding power between rail and tie at that point, but it introduces a time lag and increases the time and distance during which the pressure is delivered to the rail head.

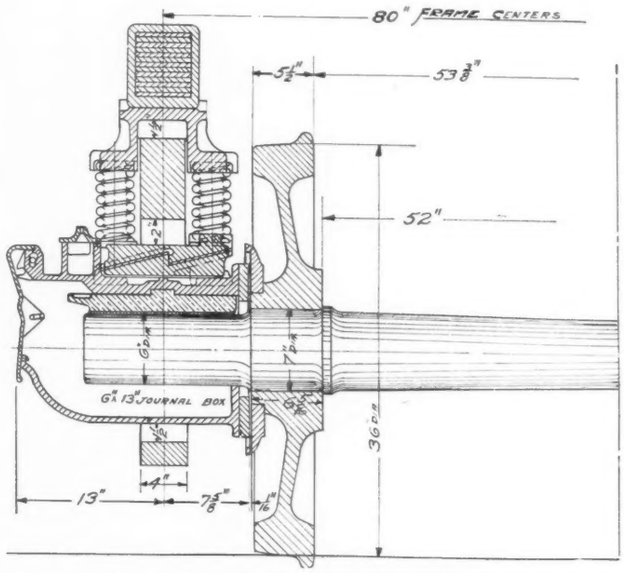
The Baldwin-Westinghouse Locomotive

The locomotive consists of two duplicate running gears of the Pacific type, placed back to back, supporting a single cab. The wheel arrangement of the locomotive is 4-6-2-2-6-4, with 68-in. drivers, a rigid wheel base of 16 ft. 9 in. and a total wheel base of 79 ft. 10 in. Rigid and floating center pins have been provided to relieve the cab structure of pulling and bumping strains, all such forces being transmitted directly through the running gear.

The articulation of the various trucks was considered one of the most important points of design. It was the endeavor to have each truck laid down so that each one would take care of itself and would not have to be led along by any of its companion trucks. During a series of tests made at East Pittsburgh, Pa., this feature of the mechanical operation of the locomotive was pronounced and the locomotive was declared to have especially good riding qualities. An extensive study was also made of weight distribution and its equalization between trucks. With this latter end in view, comparatively long spring hangers have been used so that any slight increase or decrease in their length for the purpose of shifting the load does not have any noticeable effect on the position of the locomotive springs.

Motors

The 3,000-volt direct current power is conducted through the necessary switches and resistances to six motors of the

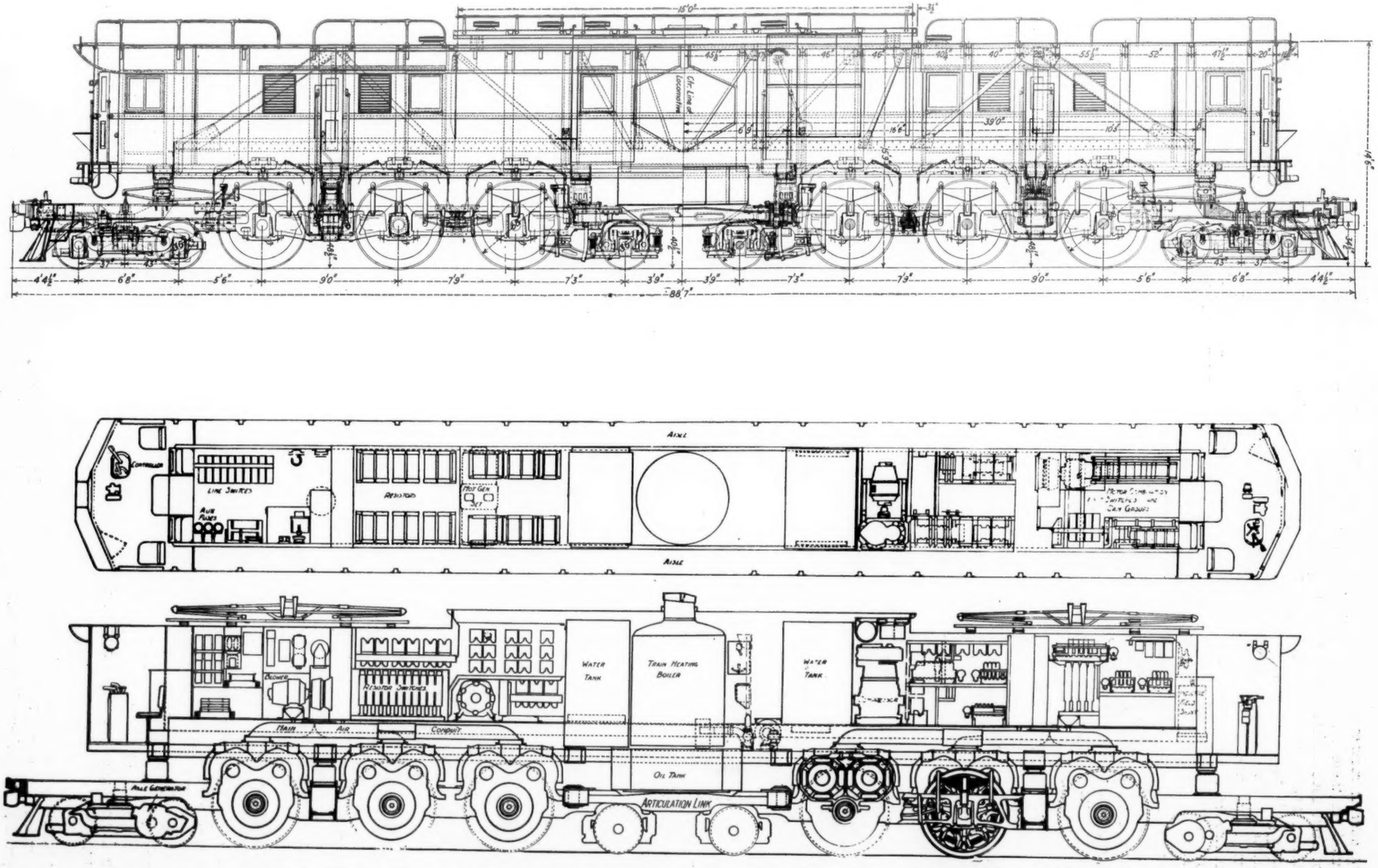


Cross Section of Journal Box, Showing Wedges Used to Give Resistance to Lateral Movement on General Electric Locomotive

twin-armature type mounted on the locomotive running gear. The two armatures of each motor are permanently connected in series, and the control is so arranged that at least two motors are always in series, with the result that the voltage across any one armature never exceeds the value of 750 volts during motor operation. In addition to this, the control is further arranged so that all main motor fields are connected on the grounded side of the circuit, thus maintaining most of the voltage stresses on the motors practically in line with commercial usage for the past 15 or 20 years.

One motor is mounted over each driving axle on the frame of the locomotive, and power from each armature is transmitted by pinions to a gear with an 89:24 reduction. The gear is mounted on a quill shaft, which is also supported on the locomotive frame, and which surrounds the locomotive axle with an appreciable clearance. The connection between the driving wheel and the quill shaft is made by springs. One end of each spring is connected to the quill shaft, while the other engages a bracket on the spoke of the driving wheel.

This arrangement permits the driving wheels to follow the unevenness of the roadbed, without affecting gear mesh, as well as cushioning the torque of the motor. In the design of this type of quill shaft the details have been governed by the experience obtained from the successful application of a similar type of drive on the New York, New Haven & Hartford locomotives, making due allowance for the increase in tractive effort.



Side Elevation and Plan and Section of Baldwin-Westinghouse Locomotive, Showing General Arrangement of Apparatus

The manner of regenerating power for operation on down grades used on these locomotives embodies features which have not been used before. The main driving motors are series motors, and in order to make them regenerate power to the line it is necessary that they be separately excited. The control of the excitation of the main motors for regeneration is initiated manually by the operator from the master controller, the exciting current coming from two small generators geared to one of the axles of each bogie truck. These small generators in turn are excited from an independent source, consisting of a motor-generator set operating in parallel with a small storage battery. All of the main motors are used during regeneration. Efforts have been made in the design of main motors and the axle generators to guard against any possibility of snow getting into the windings. One of the axle generators is mounted on each bogie truck in a standard street railway motor frame.

Control

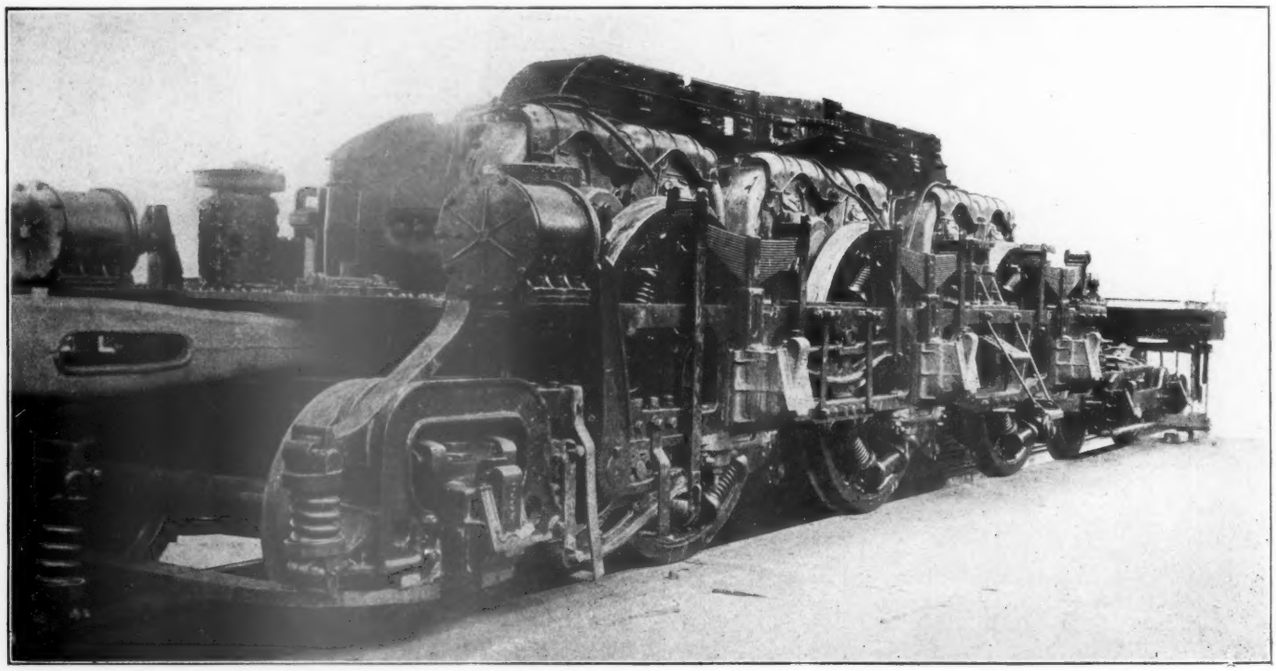
The locomotive control provides three motor combinations, giving one full series and two series-parallel connections. The two latter connections consist of two parallel circuits of three motors in series and three parallel circuits with four motors in series. In each of these motor combinations three running notches are provided, which are full field, short shunt and long shunt. This provides a total of nine running speeds without resistance connected in the circuits.

While descending a grade the excitation of the motor field is entirely under the control of the engineman and may be increased or decreased as desired, causing corresponding increments and decrements to the regenerative effort of the locomotive, thus varying the speed of the train through any desired range. The full motor capacity of the locomotive is available for regeneration, and under all conditions of grade on which it will be used it should be able to handle any train down grade that would require double-heading on the way up.

Auxiliary Apparatus

Power for energizing the control circuit and operating the auxiliary apparatus, a small blower motor, the motor-driven air compressor, etc., when these are not being driven by the axle generator, is obtained from a small motor generator set and storage battery which are used to excite the fields of the axle generators. The high-tension winding of this set is the only piece of revolving apparatus in a locomotive, with the exception of the main motors, which is connected to the 3,000-volt circuit. The low-tension side of the motor generator set is provided with slip rings for the generation of a low voltage alternating current for the headlight and for some of the interior cab lights. During motoring and when coasting without regeneration, the axle generators are automatically connected to the low voltage auxiliary circuit, so that the motor generator for the greater part of the time is only necessary for furnishing excitation to the axle generator field and for charging the storage battery. This reduces the necessary size of the motor generator set.

The center compartment of the locomotive is given up entirely to an oil-fired steam boiler, its supply tank and auxiliaries. This boiler supplies steam for heating trains and is capable of evaporating 4,000 lb. of water per hour. Two storage tanks for water are provided, having a combined capacity of 25,500 lb. of water. There is also a tank for the fuel oil, with a capacity of 750 gallons. The boiler also feeds radiators located in each of the operating cabs.



Running Gear of One Half of the Baldwin-Westinghouse Locomotive With Motors in Place

Comparative Data for the Two Locomotives

	General Electric	Westinghouse
Total weight	521,200 lb.	550,000 lb.
Total weight on drivers	457,680 lb.	336,000 lb.
Non-spring-borne weight per driving axle	9,500 lb.	7,800 lb.
Length over-all	76 ft. 0 in.	88 ft. 7 in.
Height over cabs	14 ft. 11⅝ in.	14 ft. 6 in.
Height over pantograph, locked down	16 ft. 8 in.	16 ft. 7⅞ in.
Total wheelbase	67 ft. 0 in.	79 ft. 10 in.
Maximum rigid wheelbase	13 ft. 9 in.	16 ft. 9 in.
Diameter of driving wheels	44 in.	68 in.
Diameter of idle wheels	36 in.	36 in.
Heater capacity	4,000 lb. steam. per hr.	4,000 lb.
Water capacity	30,000 lb.	25,500 lb.
Oil capacity	6,000 lb.	750 gal.
Compressor capacity	150 cu. ft. per min.	150 cu. ft. per min.
Number of motors	12	12
Type of motor	(Bi-polar) GE-100	(Twin) 4-pole

	General Electric		Westinghouse
Locomotive rating:	Tapped field	Full field	
Total horsepower, one-hour motor rating	3,480	3,380	4,200
Total tractive effort one-hour motor rating	36,000	46,000	66,000
Speed, miles per hour	36.2	27.5	23.8
Total horsepower continuous	3,200	3,200	3,360

INCREASING LOCOMOTIVE EFFICIENCY AND CAPACITY*

Improvements Suggested Include Feedwater Heating, Trailer Booster, Lighter Rods and Cut-off Regulation

By B. B. MILNER
Engineer of Motive Power and Rolling Stock, New York Central

IN discussing methods of increasing the efficiency and operating capacity of steam locomotives, I shall pass over the well worked questions of maintenance, fuel, feedwater, feedwater treatment, lubrication, stokers and the whole unlimited question of locomotive design by confining my remarks to a very few operating efficiency and capacity increasing adjuncts which I believe important because susceptible of profitable application to existing power.

Feedwater Heaters

First, I shall suggest one locomotive accessory, which in my judgment stands out with surpassing and immediate importance, viz.: the feedwater heater, an instrument by means of which a portion of the heat ordinarily rejected at the stack of a locomotive may be conserved and used by abstracting this heat from either the smokebox gases or the exhaust steam, and using it for the preheating of feedwater. Thus far the heat source of the more successful schemes for thus conserving the ordinarily rejected energy has been the exhaust steam. These schemes involve replacement of the injector. The injector is a 100 per cent instrument from the standpoint of returning to the boiler all of the heat energy delivered to it from the boiler in the form of operating or driving steam, and it does most efficiently take feedwater at ordinary temperatures and deliver it to the boiler. The energy of the steam supply is divided between elevating the feedwater temperature and imparting to it the kinetic energy necessary to drive it into the boiler, and there is practically no heat lost. Against this arrangement, a saving must be represented in elevating the temperature of the feedwater by the use, not of heat drawn from the boiler, but of heat otherwise rejected at the stack, provided, of course, that the energy consumed by the mechanical operation of the feedwater heating means does not approach closely the quantity of heat caught and used instead of being rejected. A number of such means are now currently and regularly raising the ordinary temperature of locomotive feedwater—say, from 62 deg. F. to approximately 212 deg. F., or through a range of 150 deg. F.

Twenty or more years ago, the late M. N. Forney introduced a paper on the feedwater heater with the following statement: "To convert one pound of water of zero temperature into steam of 200 lb. pressure requires 1231.7 units of heat; a unit being the amount required to raise one pound of water one degree. If the average temperature of water in a locomotive tender is 60 deg., then 1231.7 — 60 = 1171.7 units of heat must be imparted to it to convert it into steam of the pressure named. One per cent of that will be 11.71 units, so that if each pound of feedwater is increased that many—or say 12 deg. in temperature, by waste heat, before it enters the boiler, it will be equivalent to a saving of one per cent of the fuel required to convert it into steam. This is true theoretically and has often been proved practically." Therefore, a locomotive feedwater heater which raises the temperature of feedwater through 150 deg. F., gives a fuel saving of over 12 per cent—a considerable margin of saving upon which to work.

It therefore appears that the problem of successful feedwater heating by means of exhaust steam should not involve any elaborate tests, particularly directed to the ever difficult weight and work measurement of fuel economy, but may and should be properly restricted to the mechanical performance of the feedwater heating instrument, the reduction in the cost of its maintenance and the development of assured continuity of service. We are dealing with such a large actual economy that the carriers may well afford the expenditures involved in the contribution to more definitely establishing the solution of the mechanical problem involved, without any particular concern for the question of what may be the thermal results upon which actual savings in fuel consumption must necessarily be based; that is, they may well afford active contribution to the working out of whatever mechanical difficulties may yet have to be met by the application and use of feedwater heater equipment now available or hereafter developed for locomotive service.

The above has been addressed particularly to the question of efficiency or economy. The question of capacity is also favorably affected in that not only is heat reclaimed from the exhaust and used, but the condensed steam as well. And to the extent that condensation is so reclaimed, it is returned to the boiler, thereby reducing the quantity of water which must be supplied to the locomotive tender for covering a given amount of work. The quantity of steam reclaimed from the exhaust figures about 15 per cent. This means that a locomotive tender of given capacity will cover an amount of work that much greater; that either the work per unit of time may be correspondingly increased or, if this work remains constant, it may be continued for a correspondingly greater distance or time. Every pound of steam reclaimed from the exhaust reduces by that amount the weight of tank water which must be evaporated.

Trailer Booster

There has been recently developed what has come to be known as a "booster," consisting of an ordinary reciprocating steam engine geared to the locomotive trailer wheels, designed for use as may be required in the starting of trains, getting them to speed the more promptly, or both, by adding to the tractive efforts ordinarily developed at the lower speeds.

The operation of this booster is controlled by air pressure. At the front end of the reverse lever quadrant is provided a manually operated latch, by means of which the booster is made "normally" inoperative or operative when the reverse lever is in the extreme forward position. With this latch in the operative position, the reverse lever, when pushed "into the corner" engages an air valve which permits air pressure to pass from the main reservoir to the booster clutch cylinder, and thence to what has come to be known as the pilot valve, mounted back of the boiler dome. When the main throttle is opened, a supply of steam from the dry pipe to this pilot valve causes it to permit air pressure from the booster clutch cylinder to open the booster throttle valve. When the reverse lever is pulled "from the corner" or the latch at the front end of the reverse lever quadrant is 'thrown out," the booster's steam supply is cut off and the booster clutch immediately disengaged. The apparatus is, therefore, protected against damage from broken pipes, lack of air, or damage from other possible cause. When the booster is not in use, it is "out of gear" and idle, none of its parts being in operation, and the performance of the locomotive then being in no way affected by reason of the booster application.

Characteristic drawbar-pull and horsepower-speed curves

*From a paper presented before the New York Railroad Club, April 16, 1920.

taken from dynamometer car data are shown by Fig. 1, from which it will be noted that the initial drawbar-pull is, by use of the booster, increased from some 37,000 lb. to 47,000 lb., that the increase in drawbar-pull and the horsepower begins to diminish perceptibly at about 15 miles per hour, and that the booster becomes a load upon the regular locomotive cylinders at speeds approximating 20 miles an hour. Recalling, however, that the booster operation is discontinued by removal of the reverse lever "from the corner," it will be understood that interruption of booster operation is assured for quite some time before having attained even the speed of 15 miles per hour, at which the advantage in the use of the booster begins to appreciably diminish; that is, long before the diminution of this advantage occurs, and much longer before there is any possibility of the booster becoming a load on the main cylinders, the booster will always have been thrown out of gear. Fig. 1 also discloses the wide margin in the ability of the boiler to supply the booster with steam, as has been proven in service, and becomes very apparent by realization of how small are the horsepower outputs from the start up to speeds at which the booster will be thrown out of gear, in comparison with the much larger horsepowers for which locomotive boilers are all amply able to supply the necessary steam.

The booster, as a means of helping existing locomotives

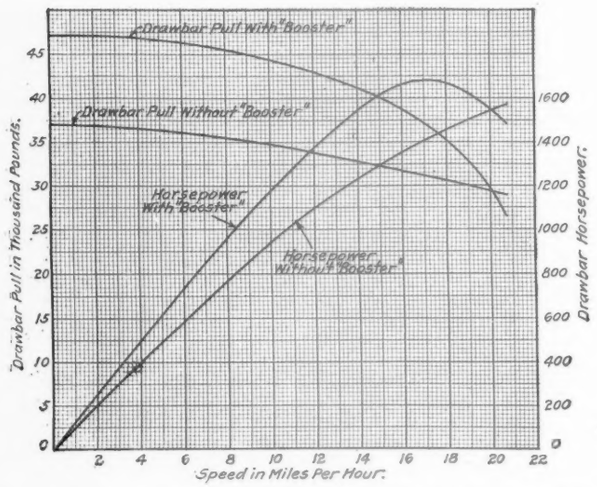


Fig. 1—Drawbar Pull and Horsepower, With and Without Trailer Booster

through work which they are now only able to do with difficulty, if indeed they are able to do at all, will result in the satisfactory handling of larger trains, increased acceleration rates, or both. Increased acceleration should be particularly valuable in frequent-stop passenger service, and the higher initial or starting drawbar pulls and the ability to start heavier trains should be valuable in both freight and passenger services under what are now trying, if not prohibitive, starting conditions. The booster is applicable to most existing trailing wheel locomotives, and should materially increase the efficiency of operation, particularly from the standpoint of the locomotive being a transportation producing instrument.

The curves in Fig. 2, however, show clearly the advantages of the booster use from an acceleration standpoint, the train hauled being one consisting of 2,210 gross tons in 104 cars on a slightly opposing grade. Note, for example, that without the booster the speed of 16 miles an hour was obtained in 450 seconds, while with the booster this speed was obtained in 250 seconds or in nearly 50 per cent less time, amounting to over three minutes. The arrangement will undoubtedly prove a valuable addition to many existing trailing wheel locomotives which have become inadequate to serve needs on account of deficiency in starting capacity, and also valuable for new trailing wheel locomotives in that greater starting power and capacity may be obtained without increasing the boiler, number of driving wheels, or materially increasing weights.

Dynamic Augment

Another way to increase the operating capacity of locomotives is to lighten the reciprocating and revolving weights by the use of alloy steel. This will permit of increasing the

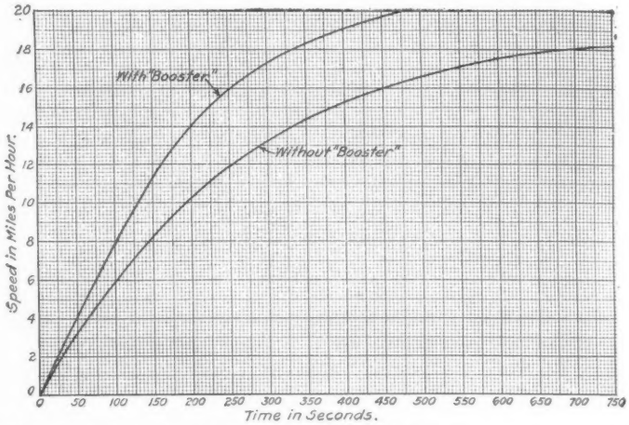


Fig. 2—Curves Showing Increased Acceleration Secured With Booster

weight of the boiler without increasing the rail pressure at speeds. In fact, the rail pressure at speeds may be actually reduced with even heavier boilers by reducing the dynamic augment of the balancing forces. This subject is sufficient for a paper by itself and may be only mentioned here.

Proper Cut-off for Maximum Horse-Power

One of the most important factors in locomotive operation and one to which very little attention has been paid, is the science involved in selecting the proper cut-off or the reverse

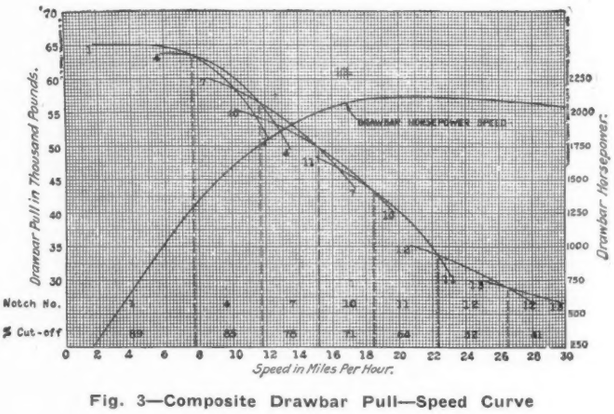


Fig. 3—Composite Drawbar Pull—Speed Curve

lever locations required at various speeds for the development of maximum horsepower or drawbar-pull. Everyone probably knows that for any and each particular speed, there is only one reverse lever position or cut-off at which the locomotive will deliver its maximum in either horse-power or drawbar-pull; that is, if this reverse lever position be notch 07, cut-off 78 per cent, at say, 14 miles per hour, in any other reverse lever position and at any other cut-off, either greater or less, the locomotive will not deliver the maximum at this speed. But how do enginemen actually select vari-

ous reverse lever positions at various speeds, or how have they been taught to select them when maximum horsepower or drawbar-pull output is desired or actually required in order to go through a "tight" situation either on account of the liability of "sticking" or of failing to make satisfactory time. I suggest that to have done so little for enginemen in this connection is, to say the least, somewhat of a reflection. To spend time and money in the arrangement and design of a locomotive, which in these days represents an investment of $60,000 or more, and then turn such an engine over to enginemen to run "catch as catch can," so far as concerns cut-off selection, is not very creditable.

The graphic chart, Fig. 3, shows the general relations existing between speeds and the drawbar-pulls developed by the use of the various constant cut-offs as represented by reverse lever notches, numbered 1, 4, 7, 10, etc., consecutively from the most forward or longest cut-off reverse lever position. In accordance with facts, this chart indicates that initial drawbar-pull at zero speed, or when starting, decreases with decreases in the cut-off used; that is, a longer cut-off will develop a higher initial drawbar-pull, whereas a shorter cut-off will develop a correspondingly lower initial drawbar-pull. This chart also indicates that at successively higher speeds, successively shorter cut-offs develop maximum drawbar-pulls, or in other words, for any speed there exists a definite cut-off at which the drawbar-pulls will be maximum and the selection of any other than the "maximum drawbar-pull cut-off," either higher or lower, will develop a lesser drawbar-pull.

It becomes, therefore, apparent that some knowledge of the precise cut-offs or reverse lever positions, which at various speeds will result in the development of the desired maximum drawbar-pull, must obtain and be used if maximum results are to be secured. What I have said covers the situation in a general way, but there remains the problem of how the necessary cut-off-speed-drawbar-pull data may best be obtained, and having obtained it how use may be made thereof. By inserting a second speed controlling engine between the dynamometer car and the train the drawbar-pulls developed by the first or leading engine ahead of the dynamometer car and under test, may be very esily obtained for all desired speeds. In Fig. 4 are shown the results of four tests made with the same engine and same train on the same day over a ruling grade indicating the advantage of using proper cut-offs.

All of the information, supplemented only by a watch, used in making the fourth and successful run covered by Fig. 4, is shown by Fig. 5, which presents the front and back of conveniently arranged vest pocket cards for the use

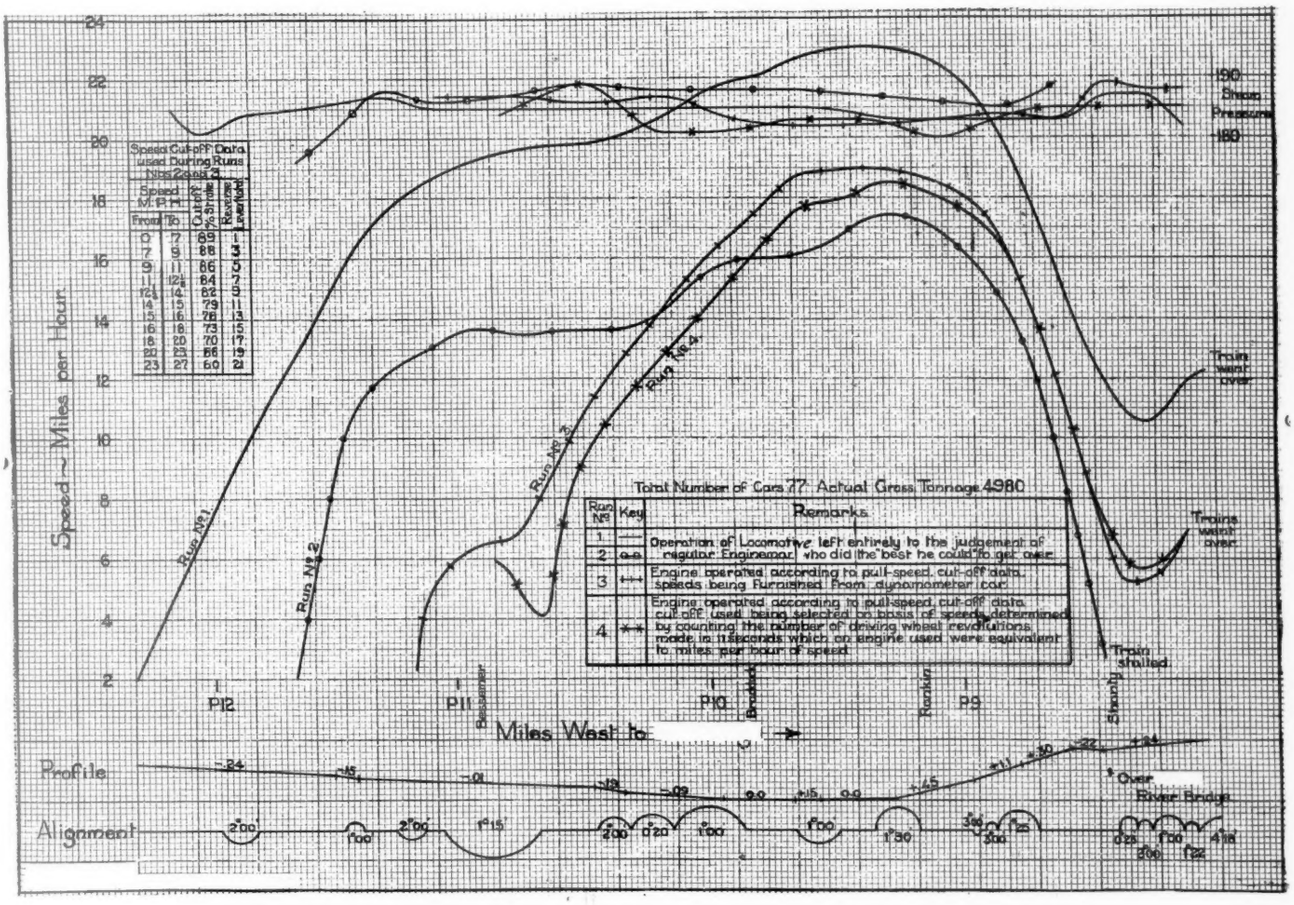

Speed ~ Miles per Hour
Run No 1
Run No 2
Run No 3
Run No 4
Total Number of Cars 77 Actual Gross Tonnage 4980
Remarks
Operation of Locomotive left entirely to the judgement of regular Engineman, who did the best he could to get over.
Engine operated according to pull-speed, cut-off data, speeds being Furnished From dynamometer car.
Engine operated according to pull-speed, cut-off data, cut-off used being selected on basis of speeds determined by counting the number of driving wheel revolutions made in 11 seconds which on engine used were equivalent to miles per hour of speed.
Train went over.
Train stalled.
Miles West to
Profile
Alignment
Over River Bridge

Fig. 4—Graphic Chart of Four Runs, Indicating the Advantage of Using Proper Cut-Off

and information of enginemen. This information is sufficient for them if they be careful, painstaking and understanding, but it must be freely admitted that the very neat selection of cut-offs from this card information cannot be expected or depended upon, because all attention possible may not be enough and enginemen have other matters for their thought and time. It is suggested that the development of automatic means of taking care of this cut-off selection matter remains to be worked out, and there is reason for believing that several mechanical schemes for covering the matter will be developed into practical form, and that, in due course, enginemen will be relieved entirely of attention to reverse levers and cut-off selection, except where less than maximum output is desired, under which conditions the engineman's mind will continue to be required, as at present,

for following instructions to "use full throttle until the shortest cut-off, meeting the speed and load requirements, or the least at which the engine will run smoothly has been reached and thereafter 'throttle' as necessary to meet speed

Statement showing reverse lever notches and cut-offs at which maximum drawbar pulls are developed.

RAILROAD October, 1919

Class H-8				Class H-9				Class K-4			
Speed M. P. H.		Cut-off (a)	Rev. Lev. Notch (b)	Speed M. P. H.		Cut-off (a)	Rev. Lev. Notch (b)	Speed M. P. H.		Cut-off (a)	Rev. Wheel Rev. (c)
From	To			From	To			From	To		
0	8	89		0	7	89	1	0	9	85	0
8	12	85		7	9	88	3	9	15	82	1
12	15	78		9	11	86	5	15	21	79	2
15	16½	71		11	12½	84	7	21	27	74	3
16½	22	64		12½	14	82	9	27	31	68	4
22	26½	52		14	15	79	11	31	35	66	4½
26½	30	41		15	16	76	13	35	40	64	4½
				16	13	73	15	40	45	62	4¾
				18	20	70	17	45	50	59	5
				20	23	66	19	50	55	53.5	5½
				23	27	60	21	55	60	46.5	6
								60	65	39	6½

NOTE.

(a) Percent of stroke.

(b) Counting from front end of fine tooth air reverse quadrant, the notch at which specified maximum valve travel is obtained; is No. 1.

(c) Screw reverse wheel revolutions are counted from full forward position (zero) at which specified maximum valve travel is obtained.

GENERAL.

In case quadrants or screw gears are changed, new notches or positions may be obtained from cut-offs shown.

(over)

(Front of Card)

USE FULL THROTTLE until the shortest cut-off at which the engine will run smoothly has been reached, then "throttle" as necessary to meet speed requirements.

DIMENSIONS

CLASS	CYLINDERS	DRIVERS
H-8	27"x30"	56"
H-9	27"x32"	63"
K-4	23½"x26"	72"

FOR ASSISTANCE IN ASCERTAINING SPEED

Note that the number of revolutions which engine drivers of the following diameters	72"	68"	63"	62"	56"	50"
Make in the following number of seconds	13	12	11.2	11	10	9
Equals the speed of the engine in miles per hour						

over

(Back of Card)

Fig. 5—Data for Guidance of Enginemen in Selecting Cut-Off

requirements." Essentially these instructions are exhibited upon the back of the enginemen's card referred to, and shown herein as Fig. 5.

Discussion

W. E. Woodward (Lima Locomotive Corporation) referred to a recent comparison of electric and steam locomotives in which the average coal consumption per horsepower-hour for steam locomotives was given at 7.86 lb. The tests on which these data were based were conducted several years ago and the results of more recent road trials showed the comparable figure for modern locomotives to be between 3.4 and 4.0 lb., demonstrating that a considerable increase in efficiency had been effected in the last few years. Mr. Woodward pointed out that a reduction in the dynamic augment is a promising method of increasing the capacity and efficiency of locomotives. The limit of driving wheel loads has now been reached, but there is no reason why the static load cannot be increased if the pressure on the rail at the high speeds developed at present is not exceeded. By reducing the dynamic augment the weight on each pair of driving wheels could be increased 10,000 lb. and this increased weight could be utilized in capacity or efficiency increasing devices. The trailer booster gives a considerable increase in the drawbar pull, with a slight increase in weight and cost, and in Mr. Woodward's opinion represents the most practical method yet devised to utilize the potential boiler capacity of the locomotive at low speeds.

George M. Basford (Locomotive Feedwater Heater Company) referred to the fact that the stability of the railroads depends on whether railroad securities are attractive to the investor, and mentioned the appliances discussed in the paper as means by which the investment in locomotives could be made to bring a higher return. Describing the performance of feedwater heaters Mr. Basford stated that temperatures as high as 250 deg. F. had been obtained with the closed type of heater, effecting a saving of 15 per cent. He called attention to the incidental increase in boiler efficiency resulting from the lower rate of combustion and evaporation, which cause an additional gain of about four per cent. Mr. Basford expressed the opinion that the field for the trailer booster was not confined to freight locomotives, but on passenger power this device would prevent delays and improve operating conditions.

W. D. Wood (Fuller Engineering Company) submitted data to show the possibility of increasing efficiency by the use of pulverized coal. He stated that a mixture of bituminous coal with 38 per cent anthracite silt having a heating value of approximately 11,800 B.t.u. per pound, was developing an actual evaporation of 6.5 to 7 lb., or an equivalent evaporation of approximately 8 lb. per pound of fuel. The over-all efficiency of the boiler burning this pulverized coal ranged from 63 to 70 per cent.

RAILROAD LABOR BOARD APPOINTED

President Wilson on April 13 sent to the Senate the appointments of the nine members of the Railroad Labor Board, which is to have jurisdiction over disputes between railroads and their employees. After considerable discussion the appointments were confirmed on April 15 and the board was at once called together by the President.

The board is composed of three representatives of the public selected by the President, three representatives of the railroad companies selected by him from six names nominated by the Association of Railway Executives, and three representatives of labor selected by the President from 10 nominations by the principal railroad labor organizations. The board is to select its own chairman and secretary and is to have its headquarters at Chicago, although it is authorized to hold meetings elsewhere. The members appointed by the President are:

Public Group: G. W. W. Hanger, assistant commissioner of the United States Board of Mediation and Conciliation; Henry Hunt, former mayor of Cincinnati and a member of the board of trustees of the Cincinnati Southern; and R. M. Barton of Memphis, Tenn., a former member of the Tennessee court of appeals.

Management Group: Horace Baker, former general manager of the Cincinnati, New Orleans & Texas Pacific; J. H. Elliott, former general manager of the Texas & Pacific and later a colonel in the Transportation Corps, A. E. F.; W. L. Park, former vice-president of the Illinois Central and later vice-president and federal manager of the Chicago Great Western.

Labor Group: Albert Phillips, vice-president of the Brotherhood of Locomotive Firemen and Enginemen; A. O. Wharton, president of the Railroad Employees Department of the American Federation of Labor and formerly a member of the Board of Railroad Wages and Working Conditions of the Railroad Administration; and J. J. Forrester, president of the Brotherhood of Railway and Steamship Clerks, Freight Handlers and Express and Station employees.

Messrs. Barton, Phillips and Baker are appointed for a term of three years, Messrs. Hanger, Wharton and Elliott for two years, and Messrs. Hunt, Forrester and Park for a term of one year.

Mr. Hanger has had an unusually broad experience in dealing with labor and wage matters during his service with the United States Board of Mediation and Conciliation, to which he was appointed in 1913 by President Wilson. He was formerly chief statistician of the Bureau of Labor Statistics. During federal control of the railroads he was an assistant to the director of the Division of Labor of the Railroad Administration. The other two representatives of the public on the board have not been identified with railroad labor questions.

The three representatives of labor on the board are entirely familiar with the questions to be handled by the board, both through long experience as labor leaders and because of their connection with the wage propositions which were submitted to the Railroad Administration and are still in an unsettled state. Mr. Wharton has been a member of the Board of Railroad Wages and Working Conditions, which has investigated all wage questions for the Railroad Adminstration since the issuance of General Order No. 27 in May, 1918, and, under the practice of that board of alternating the chairmanship between the representatives of the management and of the labor organizations, he has twice been chosen as chairman.

Mr. Baker had been general manager of the Cincinnati, New Orleans & Texas Pacific, with office at Cincinnati, from 1906 to March 1, 1920. He entered railway service as a clerk in 1878 and had later been chief clerk, trainmaster, local freight agent, division superintendent, assistant general superintendent and general superintendent. Mr. Elliott began railway work as a messenger and was later an operator, despatcher, chief despatcher and transmitter. Subsequently he was employed on the Texas & Pacific, the St. Louis & San Francisco and other roads in various capacities in the construction and operating departments. In 1914 he was appointed inspector of transportation of the Texas & Pacific and later he was promoted to superintendent, general superintendent and general manager. Mr. Park has also come up through the ranks and has had a great deal of experience in labor matters on both the side of the employees and on the side of the management. He entered railway service in 1875 as brakeman on the Union Pacific and was later freight conductor and passenger conductor, serving as chairman of the grievance committee for the conductors for a time. In 1900 he was appointed division superintendent and later general superintendent of the Union Pacific and in March, 1910, he was elected vice-president of the Illinois Central. In October, 1917, he was granted leave of absence by the Illinois Central for the duration of the war and was made first vice-president of the Chicago Great Western, later being appointed federal manager. He was a member of the board of arbitration that passed on the wage demands of the western enginemen and firemen in 1915.

Members of the board are to be paid $10,000 a year.

The board is directed by the law to hear and decide any dispute involving grievances, rules or working conditions in respect to which any adjustment board fails to reach a decision within a reasonable time, or, if no adjustment board has been organized, upon the application of the chief executive of a carrier or of a labor organization or of 100 unorganized employees, or upon its own motion if it is of the opinion that the dispute is likely substantially to interrupt commerce. It is also directed to receive for hearing and to decide disputes with respect to the wages or salaries of employees or subordinate officials. Decisions by the board require the concurrence of at least five of the nine members and in cases involving wages or salaries at least one of the representatives of the public must concur.

J. H. Manning

JAMES H. MANNING

James H. Manning, for 16 years superintendent of motive power of the Delaware & Hudson, died at Albany, N. Y., on April 15, at the age of 58. Mr. Manning's personality as well as his ability may be said to have dominated to an unusual degree the motive power department of the road with which he was connected for so many years and his death is a severe loss to the road and to the employees who regarded him as much their friend as their superior.

Mr. Manning was identified with the motive power department throughout his entire career and was remarkably successful in the administration of the wide range of executive as well as mechanical problems with which he was confronted. His official position, however, did not prevent him from retaining a warm personal contact with a large number of his employees and more than one young man in his service has been surprised by a genuine expression of sympathy or offer of assistance from his chief when circumstances were against him.

Mr. Manning entered railroad service in 1876 as a machinist on the Union Pacific. He was appointed a gang foreman in 1883 and a general foreman in 1886. In 1890 he was made master mechanic at Omaha and in 1898 was transferred to Cheyenne, in the same capacity. In 1901 he engaged in the foundry business, but in 1903 returned to the railroads as assistant superintendent of rolling stock on the Canadian Pacific. In 1904 he was appointed superintendent motive power on the Delaware & Hudson.

In recent years Mr. Manning's position placed upon him the responsibility for applying the crucial test to some remarkable developments in locomotive design. The Mallet locomotive, pulverized fuel and the feedwater heater he tested with characteristic thoroughness and persistency. It may be recalled that when Mr. Manning first tested the Mallet locomotive that had supplanted two Consolidation engines on his road, he found that the Mallet burned considerably less coal than the two Consolidations, but rather than satisfy himself with this result, he attacked the situation one year later and succeeded in securing a fuel consumption on the Mallet that was less than the fuel consumption of either of the Consolidation engines that it had replaced.

Mr. Manning needed to be sure of his ground and when his course was clear he invariably pursued it with vigor and success. He was the type of man most needed by the railroads for the mechanical problems with which they have been confronted and his loss will be keenly felt.

A Practical Freight Train Loading Method

A Simple Method for Finding the Car Factor and Equated Loading for Any Given Conditions

BY R. S. MOUNCE

Too strong emphasis cannot be placed on the importance of properly loading locomotives as a factor in increasing locomotive operating efficiency. It is almost obvious that a locomotive underloaded is wasting a portion of its hauling capacity and that one which is overloaded is retarding operation; in either case there is an economic loss.

Any train-loading method to be satisfactory must be easy to apply and should involve no loss of time in making up trains. For this reason no calculations should be left to the yard forces other than the necessary addition of gross car weights and the allowance for car friction. Allowance for car friction should be a constant quantity for a given weather condition on any division and of such a value that it will accurately equate any combination of car weights entering into the make-up of the train. It has been established that the friction allowance cannot be constant for all temperature conditions, because if it is correct for summer conditions it will be too small at low temperatures. This feature will be fully covered later.

The train-loading method given herewith has been thoroughly tested under a wide variation of weather conditions on both low grade and hilly railroads. The data have been reduced to graphic form where possible, and it is believed that the amount of calculation necessary to apply the method to specific conditions will be comparatively small.

Standard Loading Chart.—A standard loading chart showing the equated loading for an available drawbar pull of 10,000 lb. on grades from zero to two per cent, together with corresponding car factors, is taken as the basis for this train-loading method. A loading curve and its corresponding car factor are plotted for six different weather conditions in Fig. 1. It is assumed that these loading curves are applicable to speeds of from five to twelve miles per hour over ruling grades.

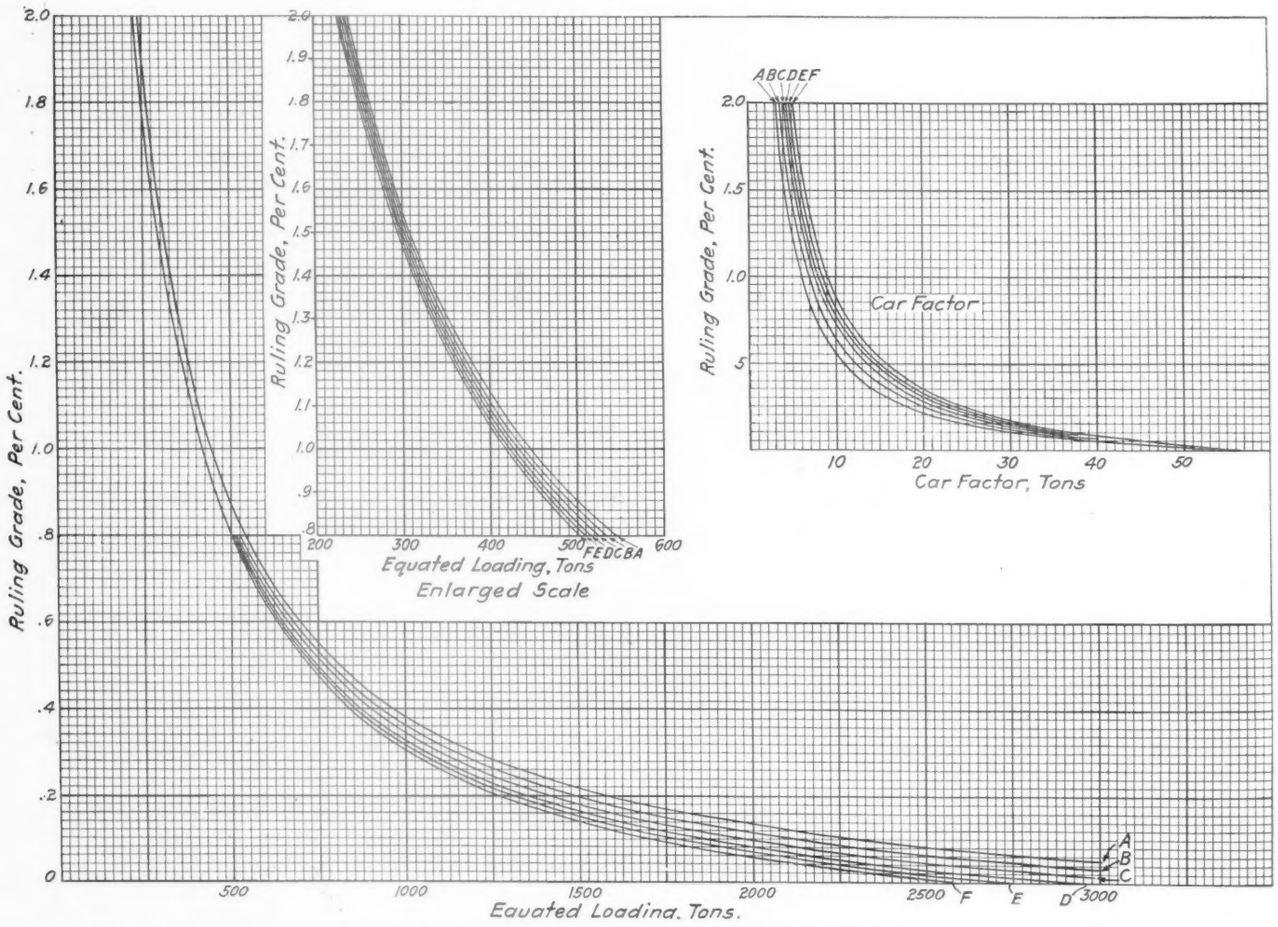


Fig. 1—Standard Loading Chart for 10,000-Lb. Available Tractive Effort at Speeds Between 5 and 12 M.P.H. Under Various Weather Conditions

Data for this chart are obtained in the following manner: Train resistances per ton for various car weights, as shown in the proceedings of the Master Mechanics' Association, for good average track conditions, were verified by further tests. These figures for 10 miles per hour were taken to be substantially correct for speeds between 5 and 12 miles per hour. The average increased train resistance per degree Fahrenheit drop in temperature has been shown by test to be .715 per cent.

The several temperature loadings are designated *A, B, C, D, E* and *F*, and the resistance per ton for cars of 70 and 20 tons gross weight as used in the chart are shown in the table below. The resistances for loadings *B* to *F*, respectively, are calculated, using the above data based on the figures 4.25 and 9.00 lb. per ton at loading *A*, for 70 and 20-ton cars, respectively.

Rating	Weather loadings: Temperature range deg. F.	Weather loadings: Average temp. deg. F.	Resistance, lb. per ton, on level tangent track: 70-ton cars	Resistance, lb. per ton, on level tangent track: 20-ton cars
A	50 and above	70	4.25	9.00
B	49 to 35	45	5.00	10.60
C	34 to 20	25	5.60	11.90
D	19 to 5	10	6.10	12.90
E	4 to —10	—5	6.50	13.80
F	—11 and below	—20	7.00	14.80

The formulæ used to derive the curves shown on the standard loading chart are:

70-ton cars—

$$\text{Train load (tons)} = \frac{P}{r}$$

$$\text{Number of cars in train} = \frac{P}{70\ R}$$

20-ton cars—

$$\text{Train load (tons)} = \frac{P}{R}$$

$$\text{Number of cars in train} = \frac{P}{20\ r}$$

$$\text{Car factor} = C = \frac{\frac{P}{R} - \frac{P}{r}}{\frac{P}{20r} - \frac{P}{70R}} = \frac{70\ (r - R)}{3.5\ R - r}$$

$$\text{Equated train loading} = \frac{P}{R} + \frac{PC}{70R} = \frac{P}{r} + \frac{PC}{20r}$$

Where P = Available tractive effort.
R = Total resistance, per ton for 70-ton cars.
r = Total resistance, per ton for 20-ton cars.

Applying these formulæ to one point on one of the curves, together with a check of the derived car factor to prove its accuracy in equating various car weights:

Assume:

Weather rating *A*
Equivalent grade, .5 per cent = G
P = 10,000 lb. (basic figure)

Then R = 4.25 + 20 G = 4.25 + 10 = 14.25 lb. per ton
and r = 9.00 + 20 G = 9.00 + 10 = 19.00 lb. per ton

$$\text{Car factor} = \frac{70\ (19.00 - 14.25)}{3.5 \times 14.25 - 19.00} = 10.7 \text{ tons}$$

$$\text{Equated train loading} = \frac{10{,}000}{14.25} + \frac{10{,}000 \times 10.7}{70 \times 14.25}$$

$$= 809 \text{ tons}$$

$$\text{or} = \frac{10{,}000}{19.00} + \frac{10{,}000 \times 10.7}{20 \times 19.00} = 808 \text{ tons}$$

In this manner the series of equated train loading and car factor curves shown in Fig. 1 are derived.

Available Tractive Effort of Locomotives—Fig. 2 shows the per cent of the theoretical cylinder tractive effort at various piston speeds up to 600 ft. per minute for modern hand-fired locomotives, both with and without superheaters. These curves are derived from reliable test data and represent good average locomotive conditions, and give a basis for calculating available tractive effort at various speeds for modern locomotives, by using the following data and formulae.

$$\text{Piston speed (ft. per min.)} = 56 \times \text{m.p.h.} \times \frac{S}{D}$$

Where m.p.h. = Speed, miles per hour
S = Piston stroke, inches
D = Diameter of drivers, inches

Internal resistance of locomotive = sum of resistances of drivers, engine and tender trucks, and grade resistance.

1. Resistance of drivers, lb. = $W_D \times 22\frac{1}{2}$
2. Resistance of engine and tender trucks, lb. = $(W_{ET} + W_{TT} + W_T)\left(3 + \frac{V}{6}\right)$
3. Resistance due to grade, lb. = $W_{TOT} \times 20 \times G$

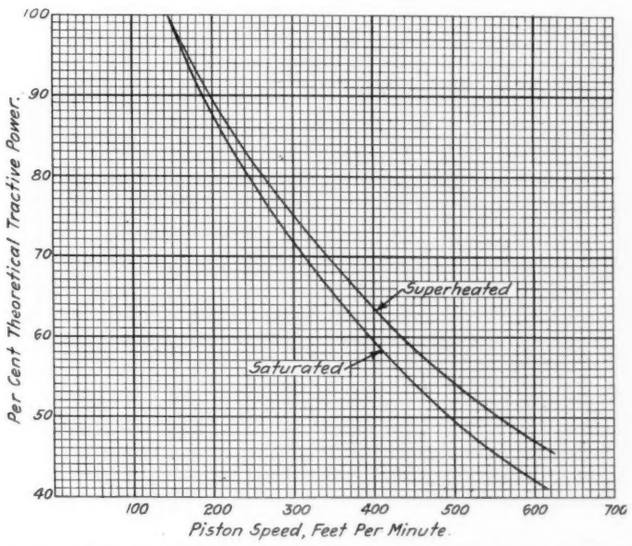


Fig. 2—Percentage of Theoretical Tractive Effort Developed at Various Speeds

W_D = Weight on drivers, tons

W_{ET} = Weight on leading truck, tons

W_{TT} = Weight on trailing truck, tons

W_T = Weight on tender, tons

W_{TOT} = Total Weight, engine and tender, tons

V = Speed, miles per hour

G = Equivalent grade, per cent

Available tractive effort = cylinder tractive effort — internal resistance of locomotive.

For each class of locomotive for which train loading data are desired, a chart showing the available tractive effort at various speeds over the range of grades encountered, should be prepared. The following example shows how easily this can be done:

MIKADO TYPE LOCOMOTIVE WITH SUPERHEATER, CLASS S-4.

Cylinders	28 in. by 32 in.
Drivers	63 in.
Boiler pressure	180 lb.
Weight on drivers	240,000 lb.

Weight on leading truck	29,000 lb.
Weight on trailing truck	52,500 lb.
Weight on engine, loaded	321,500 lb.
Weight on tender, loaded	162,500 lb.
Weight on engine and tender, loaded	484,000 lb.
Theoretical tractive effort (at 85 per cent B. P.)	60,900 lb.

Fig. 2 shows that the maximum tractive power is obtained from the starting speed up to a piston speed of 145 ft. per minute.

Substituting this value in the formula stated above:

$$145 = 56 \times \text{m.p.h.} \times \frac{32}{63}$$

m.p.h. = 5.1, speed below which locomotive will give maximum available tractive effort.

At this speed, 5.1 miles per hour, the available tractive effort on level tangent track will be:

60,900 minus resistances 1, 2 and 3.

1. Drivers $= \frac{240{,}000}{2{,}000} \times 22\frac{1}{2} = 2{,}700$ lb.

2. Engine and tender trucks $= \frac{29{,}000 + 52{,}500 + 162{,}500}{2{,}000} \times \left(3 + \frac{5.1}{6}\right) = 470$ lb.

3. Grade = O

Sum of friction and grade resistances = 3,170 lb.

Available tractive effort = 60,900 — 3,170 = 57,730 lb.

For a three per cent equivalent grade at this speed, resistances 1 and 2 are the same as for level tangent track, but:

3. Grade $= \frac{484{,}000}{2{,}000} \times 20 \times 3 = 14{,}200$ lb., and the

total friction and grade resistance = 17,370 lb.

Available tractive effort = 60,900 — 17,370 = 43,530 lb.

Plotting these two points on a chart, Fig. 3, and connecting them by a straight line, gives the available tractive effort over equivalent grades up to three per cent for locomotive Class S-4, at speeds below 5.1 miles per hour. Using the same formulae, available tractive effort curves for speeds of six, seven, eight, nine and ten miles an hour are plotted. These curves give complete available tractive effort data for Class S-4 locomotives. The same process is followed for the various classes of locomotives to be used, and these charts, of the form shown in Fig. 3, together with the standard loading chart, Fig. 1, make further calculations unnecessary and the process of obtaining standard loading over any division a comparatively simple one.

Application of the Method to a Given Set of Operating Conditions—Case I.—Typical hilly division with heavy ruling grade in one direction. Profile shown by Fig. 4, all grades compensated for curvature. The operating conditions on the *AB* division are assumed to be as follows:

Total time allowed for making a trip over the division in either direction, including terminal and road delays	8 hrs. 0 min.
Average terminal delays	1 hr. 0 min.

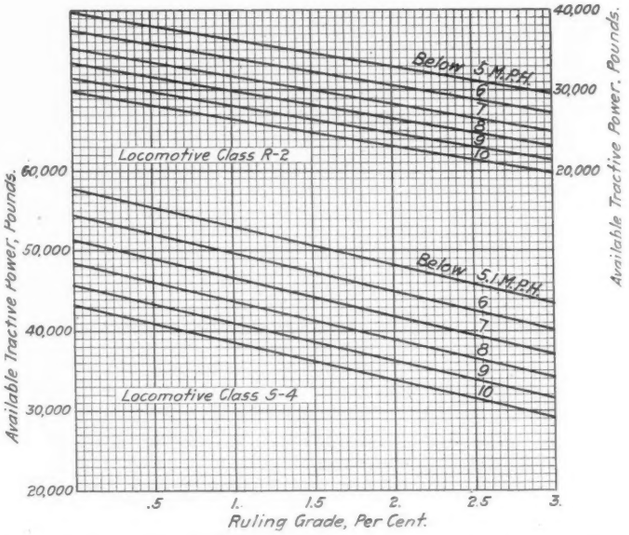


Fig. 3—Available Tractive Effort for Two Typical Locomotives Under Various Conditions of Speed and Grade

Taking water and other road delays	0 hr. 45 min.
Time left for making run within the eight hours	6 hrs. 15 min
Length of division	93 miles
Average speed over division	16½ m.p.h.

Northbound, the *AB* division has 46 miles of heavy ascending grade, 37 miles of low descending grade and 10 miles of level road. The descending grade and level portion can be covered in approximately one hour and 45 minutes, leaving four hours and 30 minutes to cover the 46 miles of ascending grade, over which the average speed will, accordingly, be slightly more than 10 miles per hour. This average speed can probably be maintained if the train loading is based on a speed of nine miles per hour over the .76 per cent ruling grade.

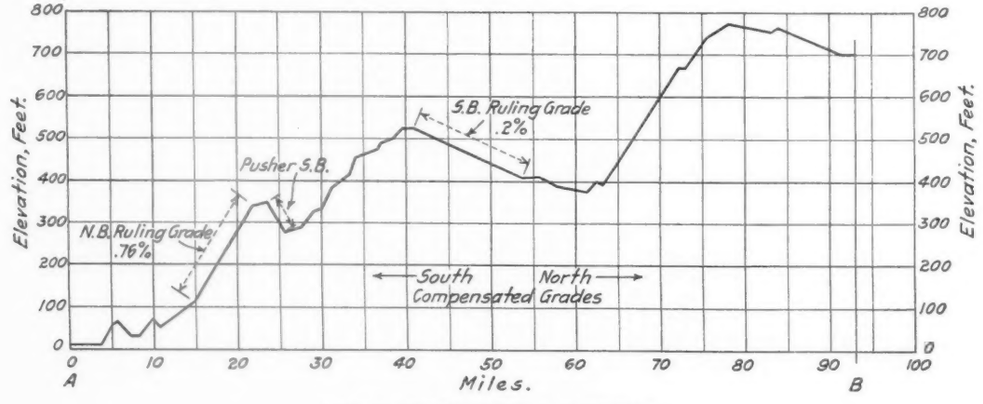


Fig. 4—Profile of the A-B Division

Southbound this division has 37 miles of low ascending grade and 46 miles of heavy descending grade and 10 miles of level road. The run over the descending grade and level

stretches will not require over two hours, leaving four hours and 15 minutes in which to make the 37 miles of ascending grade, at an average speed of 8.8 miles per hour. At a speed of 8.5 miles per hour over the .2 per cent ruling grade, which is 13 miles in length, this average speed should be easily maintained.

Assuming that train loading is desired for Class S-4 locomotives over the *AB* division, the procedure is as follows:

Northbound.—From Fig. 3, for the Class S-4 locomotive, the available tractive effort at nine miles per hour on the ruling grade of .76 per cent is 42,250 lb. (4,225 x 10,000 lb.) The standard train loading chart, Fig. 1, gives the following data for 10,000 lb. available tractive power on a .76 per cent grade:

EQUATED LOADING FOR 10,000 LB. TRACTIVE EFFORT ON .76 PER CENT GRADE FOR VARIOUS WEATHER CONDITIONS

Weather	A	B	C	D	E	F
Equated tons	565	550	540	534	530	525

Multiplying these figures by 4.225 gives the equated loading for the S-4 locomotive.

The car factor for a .76 per cent grade, taken to the nearest one-half ton is:

CAR FACTOR ON .76 PER CENT GRADE FOR VARIOUS WEATHER CONDITIONS

Weather	A	B	C	D	E	F
Equated tons	7½	8½	9½	10	11	11½

Southbound.—In a similar manner, for a .2 per cent grade and a speed of 8.5 miles per hour, the available tractive effort = 46,100 lb. (4.61 x 10,000 lb.) The equated loading for 10,000 available tractive power on .2 per cent grade is as follows:

EQUATED LOADING FOR 10,000 LB. TRACTIVE EFFORT ON .2 PER CENT GRADE FOR VARIOUS WEATHER CONDITIONS

Weather	A	B	C	D	E	F
Equated tons	1,570	1,480	1,405	1,345	1,305	1,265

CAR FACTOR ON .2 PER CENT GRADE FOR VARIOUS WEATHER CONDITIONS.

Weather	A	B	C	D	E	F
Equated tons	21	23	25	26	27	27½

The final train loading, Class S-4 locomotive over the *AB* division would then be:

EQUATED TRAIN LOADING FOR CLASS S-4, TONS

Northbound

Weather	A	B	C	D	E	F
Car factor, tons	7½	8½	9½	10	11	11½
Equated tons, locomotive, Class S-4	2,387	2,324	2,282	2,256	2,239	2,218

Southbound

Weather	A	B	C	D	E	F
Car factor, tons	21	23	25	26	27	27½
Equated tons, locomotive, Class S-4	7,235	6,825	6,475	6,200	6,015	5,830

Case II.—Typical low grade division. Profile shown by Fig. 5. All grades compensated for curvature.

The operating conditions on the *CD* division are assumed to be as follows:

Total time allowed for one way trip over the division, including terminal and road delays	12 hrs. 0 min.
Average terminal delays	1 hr. 0 min.
Taking water and other road delays	2 hrs. 0 min.
Time left for making run within the 12 hours	9 hrs. 0 min.
Length of division	138 miles
Average speed over division	15 ⅓ m.p.h.

Northbound the *CD* division has 68 miles of slightly ascending grade, 45 miles of slightly descending grade and 25 miles of level road. The run over the level and descending portions of the division can be made in about three hours, leaving six hours in which to cover the 68 miles of ascending grade, at an average speed of 11.3 miles an hour. On account of the general low grade nature of this division, the ruling portion of which is but .25 per cent northbound, this average speed can probably be maintained if the train passes over the two ruling portions, of six and three miles in length, respectively, at a speed of 10 miles an hour.

Southbound, this division has but 45 miles of slightly ascending grade, 68 miles of slightly descending grade and 25 miles of level road. The descending and level parts of the division can be covered in approximately four hours, leaving five hours in which to traverse the 45 miles of ascending grade, at an average speed of nine miles an hour. For the reason that practically all of this grade is about .2 per cent, the maximum southbound grade, nine miles per hour is taken as the speed over the ruling grade.

On account of the prevailing general low grade character of the *CD* division a smaller locomotive than the Class S-4 Mikado is to be used, the Class R-2 superheated Consolidation type locomotive having been selected. Data regarding the available tractive effort for this class of locomotive are shown in Fig. 3.

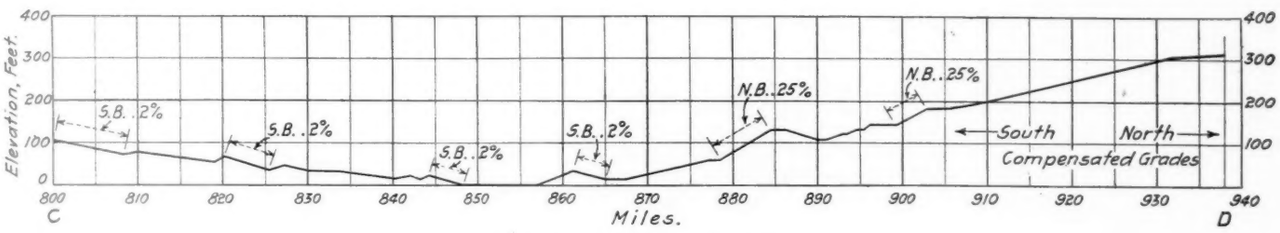


Fig. 5—Profile of the C-D Division

Northbound.—The speed over the ruling grade is assumed to be 10 miles an hour. The available tractive effort at this speed over a .25 per cent grade is 29,000 lb., or 2.9 x 10,000 lb.

From the standard loading chart, Fig. 1, the loading data for 10,000 lb. available tractive effort on a .25 per cent ruling grade is found to be as follows:

EQUATED LOADING FOR 10,000 LB. TRACTIVE EFFORT ON .25 PER CENT GRADE

Weather	A	B	C	D	E	F
Equated tons	1,195	1,140	1,095	1,060	1,037	1,012

The corresponding car factors are:

Weather	A	B	C	D	E	F
Car factor, tons	18	20	21½	22½	23½	24½

Southbound.—Similarly for a .2 per cent grade and a speed of nine miles per hour, the available tractive effort is 30,800 lb. or 3.08 x 10,000 lb. The equated loading for 10,000 lb. available tractive power on a .2 per cent grade and the car factors are:

Weather	A	B	C	D	E	F
Equated tons	1,570	1,480	1,405	1,345	1,305	1,265
Car factor, tons	21	23	25	26	27	27½

The final train loading for the Class R-2 locomotive over *CD* division would then be:

EQUATED TRAIN LOADING, TONS

Northbound

Weather	A	B	C	D	E	F
Car factor, tons	18	20	21½	22½	23½	24½
Equated tons, locomotive, Class R-2	3,465	3,305	3,175	3,075	3,005	2,935

Southbound

Weather	A	B	C	D	E	F
Car factor, tons	21	23	25	26	27	27½
Equated tons, locomotive, Class R-2	4,835	4,560	4,330	4,125	4,020	3,895

The foregoing method of freight train loading is working out very well in practice. To apply it successfully, it is of course necessary to have an accurate knowledge of the operating conditions, and profile and topography of that portion of the railroad under consideration. It is to be expected that slight changes will, in some cases, be necessary in the loading figures assigned from the standard charts used, dictated, of course, by service trials of the predetermined loadings. The basic idea in presenting this method of train loading is to afford a reasonably accurate means of loading locomotives to their economic capacity, without necessitating extensive tests to determine equated loads and friction allowances.

LOCOMOTIVES FOR THE BELGIAN STATE RAILWAYS

On March 1 the American Locomotive Company at its Schenectady works completed the first engine of the order recently placed by the Belgian State Railways. The contract for this order, which calls for 150 locomotives, 75 to be built by the American Locomotive Company and 75 by the Baldwin Locomotive Works, was signed in Brussels on December 13. It was not until December 24 that the engineering department of the American Locomotive Company was furnished the information necessary to enable it to proceed with the design of the locomotive. The design was entirely new and the metric system was used throughout, yet in 52 working days the first locomotive was completed.

While the locomotives are of American design in all their details, as will be noted from the photograph, the Belgian type of cab and tender were used. This was done in order to permit the American locomotives to couple with the existing Belgian tenders and vice versa. The Belgian State Railway's standard train connection of the screw link type with two spring buffers, the international system of threads, and French-Westinghouse brake equipment with French-Westinghouse pipe threads were also included.

These engines are to be used in both freight and passenger service and are designed for 16-deg. curves and a maximum grade of 3.3 per cent. Following European practice, all the engines are built for left-hand drive. All gages are graduated in kilograms per square centimeter.

The specifications called for a weight on drivers of 164,000 lb., weight on truck of 22,000 lb., total weight of engine 186,000 lb., and a weight limit per axle of 42,900 lb. The official scale weights are as follows:

First driver	41,600 lb.
Second driver	41,600 lb.
Third driver	41,900 lb.
Fourth driver	41,900 lb.
Total drivers	167,000 lb.
Truck	21,000 lb.
Total engine	188,000 lb.

The boiler is of the straight top type, 68 in. in diameter at the front end. It carries 200 lb. steam pressure and has a copper fire box 96 in. by 60¼ in. All staybolts are of copper, with a tell-tale hole drilled in both ends. The firebox is supported at the front end by a sliding shoe, with a brass wearing plate and a large oil groove. The jacket is supported on a crinoline frame and is extended to the front end of the smokebox. A brick arch supported on tubes and a Locomotive Superheater Company's type A superheater are also included.

The counterbalance for the reciprocating parts was divided among the eight coupled wheels, and had to be such that the dynamic augment should not exceed 15 per cent of the static weight on the rail at 60 km. (37.3 mi.) per hour.

The last five of the locomotives to be built by the American Locomotive Company are to be equipped with Worthington feedwater heaters.

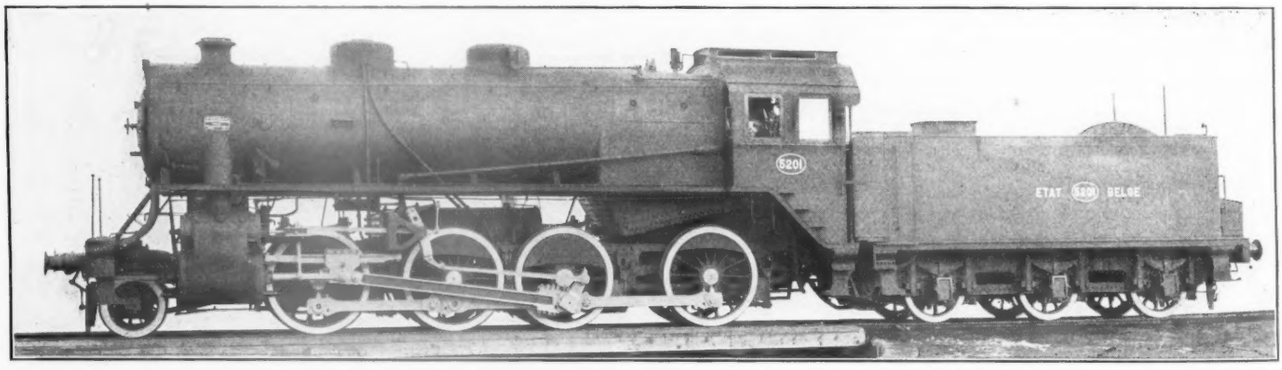
The tender frame is made of steel plate and is supported on three pairs of wheels held in rigid pedestals, the tender tank being arranged so as to drop down in between the frame.

General Data

Gage	1.435 m. (4 ft. 8½ in.)
Service	Passenger and freight
Fuel	Bituminous coal
Tractive effort	15,800 kg. (34,800 lb.) at 65 per cent m. e. p.
Weight in working order	85,276 kg. (188,000 lb.)
Weight on drivers	75,750 kg. (167,000 lb.)
Weight on leading truck	9,526 kg. (21,000 lb.)
Weight of engine and tender in working order	138,619 kg. (306,000 lb.)
Wheel base, driving	5.941 m. (19 ft. 6 in.)
Wheel base, total	8.532 m. (28 ft.)
Wheel base, engine and tender	16.344 m. (53 ft. 8 in.)
Weight on drivers ÷ tractive effort	4.79

Cylinders

Kind	Simple
Diameter and stroke	.610 m. by .711 m. (24 in. by 28 in.)



Consolidation Type Locomotive for Belgium Built in Record Time

Valves

Kind	Piston
Diameter	305 mm. (12 in.)
Greatest travel	165 mm. (6½ in.)
Outside lap	27 mm. (1 1/16 in.)
Inside clearance	3 mm. (.118 in.)
Lead in full gear	4.5 mm. (.177 in.)

Wheels

Driving, diameter over tires	1.520 m. (60 in.)
Driving, thickness of tires	76 mm. (3 in.)
Driving journals, main, diameter and length	263 in.
Engine truck wheels, diameter	.90 m. (35½ in.)

Boiler

Style	Straight top
Working pressure	14 kg. per sq. cm. (199.3 lb. per sq. in.)
Outside diameter of first ring	1.694 m. (66¾ in.)
Firebox, length and width	2.438 m. by 1.530 m. (96 in. by 60¼ in.)
Firebox plates, thickness	16 mm. (⅝ in.)
Firebox, water space. Front, 102 mm. (4 in.); sides and back, 89 mm. (3½ in.)	
Tubes, number and outside diameter	160—51 mm. (2 in.)
Flues, number and outside diameter	26—137 mm. (5⅜ in.)
Tubes and flues, length	4.724 m. (15 ft. 6 in.)
Heating surface, tubes and flues	171.7 sq. m. (1,847 sq. ft.)
Heating surface, firebox, including arch tubes	15.7 sq. m. (169 sq. ft.)
Heating surface, total	187.4 sq. m. (2,016 sq. ft.)
Superheater heating surface	45 sq. m. (484 sq. ft.)
Equivalent heating surface*	254.9 sq. m. (2,742 sq. ft.)
Grate area	3.7 sq. m.

Tender

Tank	Water bottom
Frame	Steel plate
Wheels, diameter	1.067 m. (42 in.)
Water capacity	24,000 litres (6,350 gal.)
Coal capacity	7,000 kg. (7.72 tons)

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

CAR DEPARTMENT

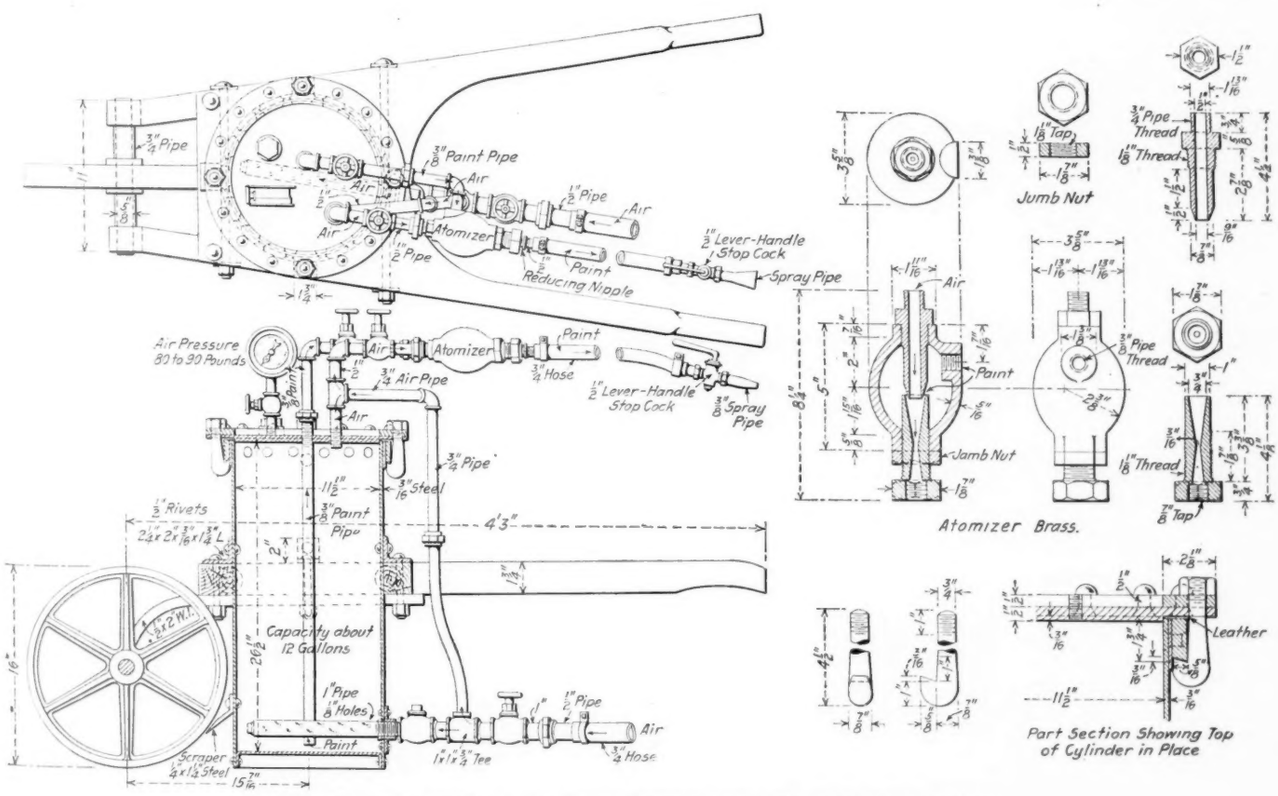
PNEUMATIC FREIGHT CAR PAINTING MACHINE

BY NORMAN McCLEOD

Considerable objection has arisen against a number of paint spraying machines used in painting freight cars, the workmen complaining of inhaling the spray when operating these appliances due to the operator having to stand too close to the outlet of the sprayer. In order to eliminate this serious feature, which imperils the health of the men, a machine has been so designed that the operator stands a considerable distance from the object being painted. This device also has the advantage of allowing the painter to have quite a lengthy pipe in his hand, the nozzle or sprayer being on the farther end and a considerable distance from his face, while with the ordinary spraying machine the spraying pipe or nozzle is practically no farther removed than the length of the operator's arm.

The machine consists of a cylindrical 3/16 in. steel tank 11½ in. by 26½ in. inside dimensions, mounted on a wheelbarrow framework which facilitates handling. The filling of the tank with paint is done with a funnel through a large filling hole located on top of the head. Cleaning, inspection or repairing is facilitated by the removable top head held in place by four hook bolts and made air tight with a leather gasket.

After filling the tank with the required amount of paint


Air Pressure 80 to 90 Pounds
Capacity about 12 Gallons
Scraper ¼ x 1½ Steel
Atomizer Brass.
Part Section Showing Top of Cylinder in Place
Jamb Nut
Leather

General Arrangement of the Paint Sprayer and Details of the Atomizer

air pressure (80 to 90 lb. per sq. in.) is introduced in two places, first through a 1 in. check valve and a perforated 1 in. pipe at the bottom of the tank and an auxiliary ¾ in. connection leading off from the 1 in. by 1 in. by ¾ in. tee between the main supply globe and check valves to a tee on a ½ in. vertical pipe in the top head. At this tee the air is diverted allowing pressure to go in the top of the tank and to the atomizer, where it is joined by the paint, brought to the atomizer through a ⅜ in. pipe the end of which reaches within ½ in. of the bottom of the tank.

CHARACTERISTICS OF SOFT METAL BEARINGS*

Discussion of the Properties Resulting from Different Compositions and Pouring Temperatures

BY W. K. FRANK

A BEARING may be defined as that member of a mechanical device which constrains a moving part in its travel. The most common type is the axle or journal bearing used in all machines having rotating journals. It may completely surround the journal or may cover only a portion of it. The journal may rotate continuously, may rotate intermittently, or may have reversing rotation. The bearing may be subjected to pressure from one direction only, as in electric motors; alternating pressure, as in engine crank-pin bearings; or alternating pressure, combined with reversed rotation of the shaft, as in engine wrist-pin bearings.

Tilting Furnace in a Bronze Foundry

It may be well to show, in passing, the position covered by plain bearings—that is, those of sliding contact—as opposed to ball- or roller-bearings, called bearings of rolling contact. Plain bearings furnish a rugged construction which is subjected to every kind of mistreatment to which a mechanical part is heir, and in the great majority of cases they do their work satisfactorily. They operate under heavy impact, continuing perhaps a thousand times a minute and 24 hours a day; in acid fumes; sometimes with scanty lubrication; under dirt or at an intense heat; often improperly aligned and momentarily required to reseat the shaft. Roller bearings are admirably fitted for certain classes of service, but the necessity of the balls or rollers being made and maintained in a condition of extreme accuracy, measured in ten-thousandths of an inch, makes them impractical under the heat at which a rolling-mill bearing or wrist-pin bearing operates. The inherent limitations of design of the rolling type prevent any considerable adjustment to compensate for the wear, which does occur, and the replacement of this product of the highest mechanical skill requires an expenditure which is not inconsiderable.

The reduction in friction, and consequent saving in power, effected by rolling bearings is a potent argument in their favor, and were it not for the limitations of application for the reasons given, this type would have found much more general application. It will, therefore, be seen that plain bearings serve a particular field and that they are called upon to render service under trying conditions.

Properties of Bronze and Babbitt Bearings

The material from which a bearing is made plays a large part in design. While bronzes and babbitts are the principal

* From a paper presented before the Engineer's Society of Western Pennsylvania. The author is vice-president of the Damascus Bronze Co., Pittsburgh, Pa.

materials used, cast-iron, wood, fiber, etc., answer for some conditions. Very little wear has been observed from some cast-iron bearings, but it should be noted that good lubrication was provided and the pressures and rubbing speeds were low. The choice between babbitt and bronze will be made from considerations of speed, pressure and temperature of operation, as will be shown later. Babbitts are softer and have lower melting points than bronzes, and are therefore adapted to conditions of lower pressure and temperature. Bearings subjected to impact should not be made from babbitts, because of the malleability of these alloys. The lower melting points and malleability of babbitts are, however, the properties that make them easy to handle and they are for

Pit Furnaces Operated with Oil and Gas.

this reason widely used. Accurate bearings may be secured without expensive machining, or they may be die cast and made into intricate shapes without any machining whatsoever. Their plastic character allows them to conform to the load and prevents localized pressures. Bronzes, on the other hand, have comparatively high melting points and are, therefore, not so easily handled. They are generally furnished by a bronze foundry in the form of castings, whereas babbitts are supplied in ingot form for application directly by the equipment builder and user.

Bearing metals are essentially a mixture, the components of which are distinctly different in hardness. In these metals the softer crystals are abraded faster and develop into depressions, allowing the harder ones to stand above them and support the load. These softer crystals perform another function also. A bearing should be plastic to a limited degree, since fitting is more or less of a rough approximation. Furthermore, a change in alinement of the shaft will produce points of concentrated pressure and the bearing must be capable of reseating itself to distribute its load properly.

Another bearing requirement is that it shall protect the shaft against injury. Unfortunately, wear is always an attendant evil of motion, and it is preferable that the bearing wear rather than the shaft. In most designs the bearing is the less costly part and is the more easily replaced, hence its harder element should be softer than the shaft. The bearing should also be of such a nature that it will not grip or be capable of welding itself to the shaft in case it becomes heated, as serious damage will be done should this occur.

It will, therefore, be seen that the range of selection for bearing metals has been greatly limited by these considerations. The use of pure metals has been excluded because of the necessity for components with greatly dissimilar wearing properties. We are, therefore, dependent on alloys, and on those alloys of which the harder crystals are softer than the shaft; which are capable of conforming to the load and yet able to carry it without rupture or undue distortion; and which do not tend to weld on heating. Other considerations require that these alloys conduct and radiate the heat of friction readily, that they wear slowly and show small friction and that they be capable of uniform production.

The only alloys we know of which combine the desired properties are the bronzes and babbitts. Babbitts fall into two general classes — namely, the tin-base metals and the lead-base metals. Antimony, copper and zinc are the principal ingredients with the tin and lead, but sodium, cadmium, calcium, barium, bismuth, nickel or aluminum are added in some cases.

The tin-base, or so-called "genuine babbitts," are variations of Isaac Babbitt's original formula of 89.3 per cent tin, 3.6 per cent copper, 7.1 per cent antimony, and they vary in the percentages of all of these elements and sometimes contain lead or other metals. In these alloys the tin furnishes a plastic matrix, in which are embedded the harder crystals of the tin-antimony, copper-tin or copper-antimony compounds.

A microphotograph of a tin-base metal is shown in Fig. 1. The dark background is the plastic tin matrix, the cubical crystals the tin-antimony compound and the six pointed "snow crystals" the copper-tin compound. In the lead-base alloys the hard crystal forming elements are principally antimony

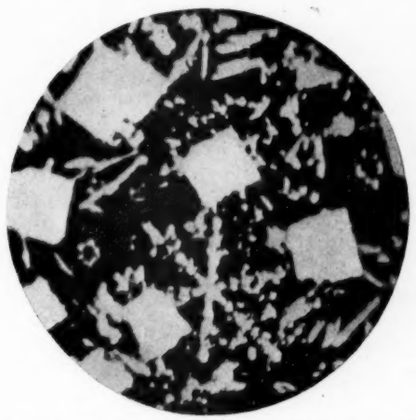


Fig. 1. Tin-Base Babbitt, Magnified 75 Diameters, Etched with Five per cent HNO_3

and tin. The matrix is lead, an alloy of lead and tin, or the lead-antimony tin eutectic, and the hard crystals are usually the antimony-tin compound.

In Fig. 2 is shown a typical lead-base structure, with the soft eutectic forming the supporting medium for the hard, cubical, tin-antimony crystals. In the case of lead hardened with sodium, cadmium, etc., these elements probably form compounds with the lead, the compounds constituting the hard crystals embedded in the lead matrix. Lead-base babbitts present a wide range of compositions and are commonly composed of lead, tin and antimony. With a variation possible in each of these elements, it may easily be seen that almost an infinite number of combinations may be made. The lead is varied between 65 and 90 per cent, the tin between 0 and 40 per cent and the antimony between 5 and 20 per cent. Varying physical properties are obtained by different formulas, and selection of the proper one is determined by the character of the load, hardness of the journal, lubrication, pressure and speed.

Babbitts are covered by tentative specification B 23-18 T of the American Society for Testing Materials (Table 1). The physical properties appended to the specification (Table 2) do not form part of it, but are merely to be taken as infor-

mation regarding the properties that might be expected from carefully manufactured alloys. It will be seen that the Brinell hardness (all Brinell figures in this paper refer to a 300-kilogram load on a 10-millimeter ball, applied for 30 seconds) varies from 14.3 in the lead-base to 34.4 in the tin-base, and that the deformation with a load of 10,000 lb. varies from 0.007 in the tin-base alloys to 0.285 in the lead-base alloys. These properties indicate why tin-base alloys are preferred for some services, in spite of their higher cost.

It has been pointed out that pouring temperatures of babbitts largely influence their resistance to continued impact. The properly prepared tin-base alloys showed little difference in this particular from the properly prepared lead-base alloys, but it was stated that the allowable pouring temperatures of the tin-base babbitts showed a greater range than the temperatures for lead-base babbitts. The former are, therefore, more often properly poured and show better properties.

TABLE I

A. S. T. M. BABBITTS. SPECIFICATION B 23—18 T

Alloy, grade No.	Tin, per cent	Antimony, per cent	Lead, per cent	Copper, per cent	Iron, max., per cent	Arsenic, max., per cent	Zinc, per cent	Aluminum, per cent
1	91	4½	0.35*	4½	0.08	0.10	none	none
2	89	7½	0.35*	3½	0.08	0.10	none	none
3	83⅓	8⅓	0.35*	8⅓	0.08	0.10	none	none
4	75	12	10	3	0.08	0.15	none	none
5	65	15	18	2	0.08	0.15	none	none
6	20	15	63½	1½	0.08	0.15	none	none
7	10	15	75	0.50*	....	0.20	none	none
8	5	15	80	0.50*	....	0.20	none	none
9	5	10	85	0.50*	....	0.20	none	none
10	2	15	83	0.50*	....	0.20	none	none
11	..	15	85	0.50*	....	0.25	none	none
12	..	10	90	0.50*	....	0.25	none	none

*Maximum.

Babbitts as a class show high plasticity combined with low Brinell hardness and compression strength, and these properties limit their application. Bronzes are, therefore, used where higher physical properties are desired to resist pressure or impact, or to provide longer service. Whereas, in the case of the babbitts the softer element is the major constituent, so in the bronzes it is the minor constituent. Bearing bronzes are, in general, copper-tin matrices filled with lead. The term bronze applies strictly to a copper-tin mixture as differentiated from brass—a copper-zinc mixture. These terms are frequently loosely used, and it is quite common to speak of bearings as "brasses." On the other hand, manganese bronze, "Tobin" bronze and a multitude of other so-called bronzes are in reality brasses, to which possibly one or two per cent tin has been added; and aluminum bronze is usually a mixture of copper and aluminum, sometimes with a small quantity of iron.

The American Society of Mechanical Engineers Committee on Bearing Metals recently pointed out why bronze is preferred to brass in bearings. This has long been understood, and the explanation given is undoubtedly the proper one. In the case of a bronze bearing metal of 90 copper, 10 tin, we secure a mixture of at least two dissimilar crystals and possibly three. In the case of copper and zinc, only one set of crystals is formed, up to a high zinc content. A homogeneous mass is formed as contrasted with the non-homogeneous mass of hard and soft elements in the copper-tin alloy, and the latter mixture is desirable because of the formation of the minute oil reservoirs. The shop man will tell you that, in a bearing, brass is dry and harsh as compared with bronze, and it is undoubtedly the property of providing oil cells that gives bronze its value as a bearing metal.

Copper-tin mixtures have good hardness and compression strength. An increase is noted with additions of tin up to about 30 per cent, although at about 12 per cent brittleness begins, owing to the increase in the eutectoid or "bronzite" constituent. Some bearings which require high compressive strength contain more than 12 per cent tin, but they should be used with caution. The 90 copper, 10 tin alloy shows Brinell hardness of about 70 and compression of 0.20 on a one-inch cube under 100,000 lb. per sq. in.

Fig. 2. Lead-Base Babbitt, Magnified 75 Diameters. Unetched

The majority of copper-tin bearings contain less than 12 per cent tin and combine hardness with ductility. They are limited to service where alinement is good, as they do not possess sufficient plasticity to conform readily to a shifting load. They find use in some machine tools and similar equipment, where good alinement may be maintained, and are used abroad on some railroad equipment where speeds and pressures are not excessive and where fitting is carefully performed. With ideal service conditions, a copper-tin bearing will probably outwear bearings containing added metals, but in most classes of service localized pressures caused by changing alinement will produce rapid wear and heating in this composition. Zinc is sometimes added to copper-tin mixtures,

TABLE II

A. S. T. M. TABLE SHOWING PHYSICAL PROPERTIES OF WHITE METAL BEARING ALLOYS (APPENDIX TO SPECIFICATION B 23—18 T)

Alloy No.	Formula: Copper, per cent	Tin, per cent	Antimony, per cent	Lead, per cent	Deformation of cylinder 1¼ in. diam. by 2½ in. high at 70° F., in.: At 1,000 lb.	At 5,000 lb.	At 10,000 lb.	Brinell hardness: At 70° F.	At 212° F	Melting point: Deg. F.	Deg. C.	Complete liquation point: Deg. F.	Deg. C.	Specific Gravity	Weight: Oz. per cu. in.	Grams per cu. in.	Proper pouring temperature, deg. F.
1	4.5	91.0	4.5	....	0.000	0.001	0.015	28.6	12.8	437.0	225	699.8	371	7.34	4.24	120.28	824
2	3.5	89.0	7.5	....	0.0000	0.0015	0.0120	28.3	12.7	460.4	238	683.6	362	7.39	4.27	121.10	808
3	8⅓	83⅓	8⅓	....	0.0010	0.0045	0.0070	34.4	15.7	462.2	239	791.6	422	7.46	4.31	122.25	916
4	3.0	75.0	12.0	10.0	0.0005	0.0025	0.0090	29.6	12.8	365.0	185	555.8	291	7.52	4.35	123.23	680
5	2.0	65.0	15.0	18.0	0.0010	0.0030	0.0090	29.6	11.8	365.0	185	536.0	280	7.75	4.48	127.00	661
6	1.5	20.0	15.0	63.5	0.0015	0.0050	0.0180	24.3	11.1	365.0	185	512.6	267	9.33	5.39	152.89	638
7	...	10.0	15.0	75.0	0.0010	0.0050	0.0230	24.1	11.7	464.0	240	500.0	260	9.73	5.62	159.44	625
8	...	5.0	15.0	80.0	0.0020	0.0090	0.0620	20.9	10.3	469.4	243	500.0	260	10.04	5.80	164.52	625
9	...	5.0	10.0	85.0	0.0040	0.0120	0.0840	19.5	8.6	469.4	243	491.0	255	10.24	5.92	167.80	616
10	...	2.0	15.0	83.0	0.0010	0.0100	0.1540	17.0	8.9	473.2	245	500.0	260	10.07	5.82	165.02	625
11	...	....	15.0	85.0	0.0010	0.0100	0.1190	17.0	9.9	476.8	247	500.0	260	10.28	5.94	168.46	625
12	...	....	10.0	90.0	0.0025	0.0170	0.2850	14.3	6.4	476.8	247	509.0	265	10.67	6.17	174.85	634

and the familiar gun-metal is composed of 88 copper, 10 tin, 2 zinc, but the most widely used bearing mixture is the copper-tin-lead bronze.

In bronzes containing lead, the reservoir-forming property is further enhanced. The lead does not combine with the copper-tin structure, but is only mechanically held by it in the form of globules. It imparts plasticity to what would otherwise be a more or less rigid structure, in addition to furnishing it with additional oil reservoirs.

A typical copper-tin-lead bronze is shown in Fig. 3. The light colored matrix is the harder copper-tin structure, while the light globules surrounded by dark margins are of similar composition, but richer in copper and softer than the matrix. The black globules are the lead and are still softer. It will, therefore, be seen that three distinct hardnesses are present. In this mixture we maintain the hard, wear-resisting points of the copper-tin alloy and can vary plasticity by varying the lead content. The lead can be added up to 50 per cent, and this variation gives the different properties required by varying classes of service. In some cases a very small quantity of lead is added. It produces hot shortness and is therefore not desirable in hot-mill bearings. These may run at very high temperatures, and bearings containing much lead will break under the pressures encountered. A typical low-lead formula of this type would be 91 copper, 8 tin, 1 lead.

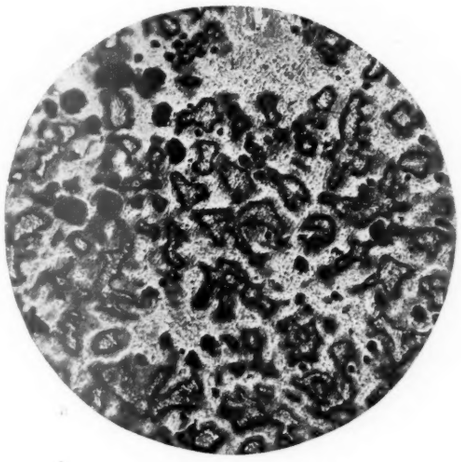


Fig. 3. Copper-Tin-Lead Bronze, Magnified 100 Diameters. Etched with $H_2O_2 + NH_4OH$

At the other end of the scale are found the high-lead mixtures containing up to 30 per cent lead. They find limited application because of their high plasticity and consequent distortion. They answer well the requirement of protecting the shaft, but do not, on the other hand, transmit heat readily. They show rapid wear, as is evident to anyone who has examined a pile of scrapped railroad car bearings. The high-lead bearings can be readily distinguished from the moderately leaded ones by the extent to which the axle collar has worn into the ends of bearings of the two classes. High-lead mixtures were originally designed to replace the babbitt-lined railroad car bearings, but do not possess sufficient plasticity to accomplish this and are used with babbitt linings. Because of this lining they seldom come in contact with any part of the journal, excepting the collar, and their length of service is determined by the life of the lining, distortion of the back and collar wear.

It is, moreover, true that high-lead mixtures are difficult of uniform production. Since the lead is but mechanically mixed with the copper-tin alloy, and as lead has a much higher specific gravity, segregation to a greater or less degree is liable to occur in the crucible and mold. Lighter castings which cool quickly can be made with some degree of success, but lead segregation of heavy castings is an accepted evil. Auxiliary agents, including nickel, ferro-manganese and sulphur, are used as preventatives of segregation, but these are not reliable expedients. Referring again to the scrap pile—the testing laboratory of experience—bad segregations in fractures of a large number of high-lead bearings are revealed. While it is not stated that castings cannot be produced without segregation, it is true that this mixture is easily mishandled and bad bearings result. Unfortunately, low initial cost has recommended it to some users. Conservation of tin during the war led the United States Railroad Administration to specify high-lead bearings for the new cars purchased. The bearing manufacturers will benefit by the replacement that will inevitably be required. A typical mixture consists of 65 copper, 5 tin, 30 lead.

As in many matters, the best lies between the extremes, and in this case the moderately leaded bronzes best answer most bearing requirements. They can be produced uniformly and well, as no great difficulty is experienced from segregation of the lead. Alloys of this class range from 5 to 15 per cent lead, and 12 to 7 per cent tin, with the remainder copper. Copper, tin and lead all tend to form oxides readily, and deoxidizers are often added. Phosphorus is the most effective of these, and is usually added in quantities in excess of that required for deoxidization and produces an additional hard constituent in the bronze. Phosphor-bronze, as the resulting alloy is called, is one of the most valuable of alloys in present-day use, for a great variety of requirements. It presents a comparatively hard surface, and yet is sufficiently plastic to conform to moderate changes in alinement. It answers all the essentials of a good bearing, for moderately good conditions of service. The standard formula calls for 79.7 copper, 9.5 lead, 10 tin, 0.8 phosphorus, and should specify less than ½ per cent impurities, as too often scrap metals are compounded to produce this alloy and the resulting trouble is charged to the formula, rather than to the impurities contained. For varying degrees of hardness the lead and tin may be varied between certain well-defined limits. The standard formula shows Brinell hardness 60, and compression of 0.25 on a one-inch cube under 100,000 lb. per sq. in.

As far back as 1892 Dr. Dudley of the Pennsylvania Railroad determined the practical limitation of lead content for car bearings to be in the neighborhood of 15 per cent. Later work on this subject has not altered the conclusions he reached in this respect, and it may be of interest to note that 27 years later a table of railroad specifications shows the net average content of 15 per cent lead and 8 per cent tin. Dr. Dudley's experiments were real service tests. It should be remembered, however, that while the 12½ per cent lead and 15 per cent lead alloys wore more slowly than phosphor-bronze in railroad car bearings, this is not conclusive proof that the lead is in itself a wear-retarding element. Lead furnishes the means of allowing the bronze to conform more readily to varying alinement and, by preventing localized pressures, reduces wear. Under the comparatively low pressures and absence of impact, but with the changing alinement of car axles, the 15 per cent lead alloy shows superiority; whereas, under high pressures and impact the phosphor-bronze shows slower wear. It is necessary only to compare the pressures of car axles of 325 lb. per sq. in. of projected area with pressures of 3,500 lb. per sq. in. of projected area, encountered in rolling-mill practice, to demonstrate why 15 per cent lead alloys are not suitable for the latter condition.

Heavy cuts in machining may seriously injure a bearing bronze. Some years ago trouble was experienced by heating in the driving-wheel bearings in new locomotives of one of the railroads. Our company had furnished the bearings and we were called upon to explain the trouble. Chemical analysis of the bronze was made and found satisfactory. The fracture revealed nothing to the naked eye, but when a section was

polished and placed under the microscope the condition shown in Fig. 4 was noted at the machined edges; whereas, normal structure, as in Fig. 5, was found in the interior points. It was then apparent that heavy cuts in machining had actually forced a large part of the lead from the copper-tin-sponge, and a rigid structure was the result. It was suggested that ⅛ in. be machined from the bearing journal surface to eliminate this distorted metal, and after this was done no further heating was experienced.

Some explanation should be made of the lack of suitable bearing testing machines. It is true that some machines have

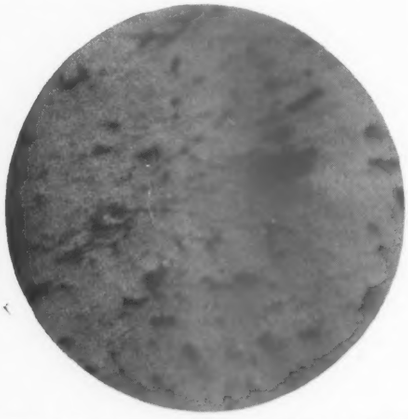


Fig. 4. Distorted Bearing Bronze, Magnified 100 Diameters. Unetched

been designed, but their value lies mainly in the testing of the lubricant. It is practically impossible to duplicate service conditions on the present types of apparatus and, from the foregoing discussion of variations in lubrication and of shifting pressures, this may be understood. With imperfect lubrication, large differences on the same identical test bearing will be noted on different days, and the explanation probably lies in the varying approaches to perfect lubrication obtained.

Tensile and compression tests are sometimes employed to check the uniformity of a given formula, but their extended use is more or less limited by considerations of the expense

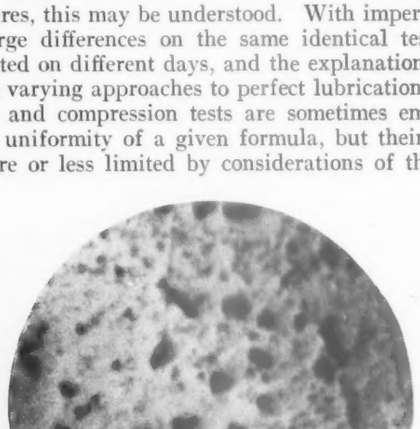


Fig. 5. Normal Bearing Bronze, Magnified 100 Diameters, Unetched

involved. Analysis is commonly used to check the desired formula, but even this is faulty. The same formula may show large variations in structure caused by different pouring temperatures, or rates of cooling. Structure is obviously the factor which determines the bearing value and; while a microscope may show the arrangement of the elements, it does not measure hardness or plasticity. The Brinell or other hardness value does not give much information. Little can be expected at present from inspection tests.

As in many other fields, a reliable manufacturer should be consulted for his experience with similar conditions. When suitable alloys are obtained he should be required to maintain uniformity of properties in the alloys subsequently delivered. It should be pointed out that the use of scrap mixtures is a common source of the varying service obtained in bearings and that uniform results can be obtained only from alloys composed of new metals, produced with standardized melting and molding practice. Unfortunately, initial price considerations sometimes rule in the purchase of bearing alloys, and the final cost per unit of service is much higher than would be the case with a slightly higher initial outlay.

Discussion

In the discussion following the presentation of this paper, John S. Unger, manager of the Central Research Bureau of the Carnegie Steel Company, stated that he believed the common practice of purchasing bearing metal of either bronze or white metal by analysis was wrong. He expressed the opinion that all bearing metals should be purchased on their mechanical and physical properties, for the reason that these properties in the same metal may be decidedly influenced by the number of times the metal has been remelted, by the pouring temperature and the size and volume of the bearing. His opinion was based on the fact that the temperature at which a soft metal bearing is poured exercises a pronounced influence on the ductility of the metal, as is readily shown by the tensile strength, compression, hardness and wearing properties.

T. B. Lynch stated that his experience had been that if soft metal was poured at too low a temperature it crumbled under the compression test; when poured at 450 deg. C it showed good ductility, and when poured at a dull red the test would shear off with an angular break or crack and burst. He stated that his observations did not agree with the temperatures recommended by others, who advised pouring some six lead-base metals at 330 deg. C, and suggested that further investigation be made to determine the best pouring temperatures for the several classes of soft metals.

(*The second section of this article, dealing with lubrication, will appear in the June issue.*)

KILN DRYING OF GREEN HARDWOODS

Technical note No. 90, issued by the Forest Products Laboratory, United States Forest Service, points out the need for a mechanically perfect heating system in kiln-drying hardwood lumber green from the saw. The successful kiln-drying of such lumber requires a very even control throughout the kiln at all times, variations in temperature of even a few degrees or variations in relative humidity of 0.5 per cent seldom being permissible. Such uniformity is possible only when the heating coil is properly drained, is relieved of air, and is distributing heat uniformly along its length.

It is the contention of the Forest Products Laboratory that the return-bend heating coil system, by bringing about more uniform distribution of heat in the kiln, enables the operator to obtain quicker and better drying than is possible with the header-coil system as it is generally installed.

The return-bend heating coil gives practically an even heat distribution under any steam pressure. The header-coil produces different temperatures at either end of the kiln, the extent of variation depending on the steam pressure, length of coils, drainage, traps, etc.

Refractory hardwoods require low temperatures, and the lower the temperatures used, the more evident will be the difference in the results obtained with these two types of heating equipment. Under the same careful operation, green hardwood lumber may be turned out from kilns using the one type satisfactorily dried, and from kilns using the other type, over-dried at one end and under-dried at the other.

FREIGHT CAR REPAIRS ON THE E. P. & S. W.

An Outline of General Policies that Have Brought Results With Details of Some of the Work Done

BY A. M. DOW
General Foreman, Freight Car Repairs, El Paso & Southwestern

A PRACTICAL REVIEW of the methods of carrying on the work in general on the El Paso & Southwestern as well as some of the detail parts of the work, may be of practical use to those in charge of the car departments of the railroads. Let us consider first the work of the light or running repair forces, who are working directly under one of the assistant general foremen of freight car repairs. The repair track inspector begins work 20 min. before the men every morning and carefully checks the bad order cards,

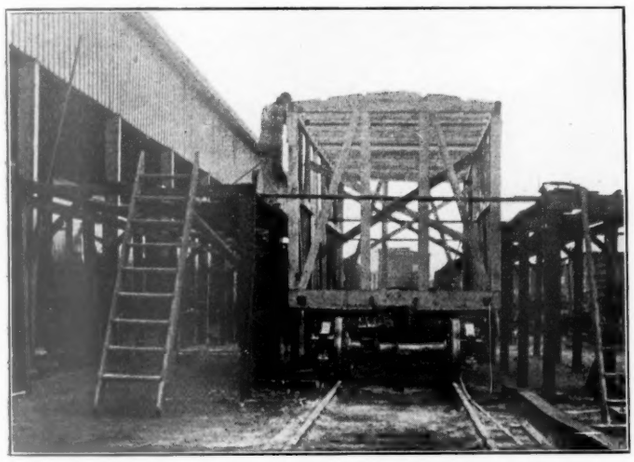


Fig. 1—Wooden Cars Completely Rebuilt On a Seven Hour Schedule

and inspects the cars to see that all defects are marked up on the cards as a guide to the men in working the car. One track is worked out completely, then the force works back on another track, and so on over the five different tracks during the eight hour period. A switch engine pulls off all cars that are finished at the noon hour, and at such other times as needed. So far as the light or running repairs are concerned, the methods in use are not very different from any other repair points, except that not more than two men are allowed to work on one job at a time. There is no necessity of more than two men for any light repair work, and, if more than two men are on a job, we find they are in one another's way to such an extent as to be a detriment rather than a help.

While this regular day's program is being carried out by one of the assistant general foremen and his force, the other assistant general foreman and his force are engaged in repairing the wrecked cars, heavy steel repairs, rebuilding and reinforcing old wooden equipment, etc. The two assistant general foremen change places every 30 days in order that each may keep in full touch with the entire force and all the different classes of the work. It is also found that the men remain at a higher point of efficiency through the change of supervisors.

Systematizing Heavy Repairs

To illustrate the method used in handling our heavy work it may be interesting to describe in detail the rebuilding of a series of 250 steel underframe wooden superstructure stock cars, which was undertaken and carried through at what we consider a very rapid rate, and at a very economical labor cost per car. The work was systematized in the following manner: A schedule was figured out composed of a series of individual operations. On each one of these operations were placed just enough men to perform that operation in a period of time which was previously determined upon as the unit of the schedule. In the case of this series of cars it was desired that one of these cars be turned out of the shop complete in every respect every four and one-half hours, which was done, at an average labor cost of $15.07 per car. The schedule was arranged as follows:

Gang No. 1. Four men stripped the superstructure of the car, removing all decking, all broken, decayed, or crooked posts, and side and end plates, in fact stripping the car completely.

Gang No. 2. Three men erected the framing complete, and applied all tie rods.

Gang No. 3. Three men applied the outside slats and roofs.

Gang No. 4. Two men applied the inside slats, running boards, doors, and safety appliances.

Gang No. 5. Two men did all truck and steel work.

Gang No. 6. Two men made side doors and did air brake work.

Gang No. 7. One man painted the car.

In all seven gangs with a total of 17 men turned out a complete car every four and one-half hours, at a labor cost of $15.07 per car. This is a record of which we were proud. It is true this work was done in 1915, and that the average wage paid per hour was 19.7 cents. The majority of the men could not speak our language, and, with the exception of three or four men, up to the time we hired them and placed them on this work, had never done car work of any kind.

After completing this series of stock cars the task of applying steel center sills and rebuilding a series of 82 all

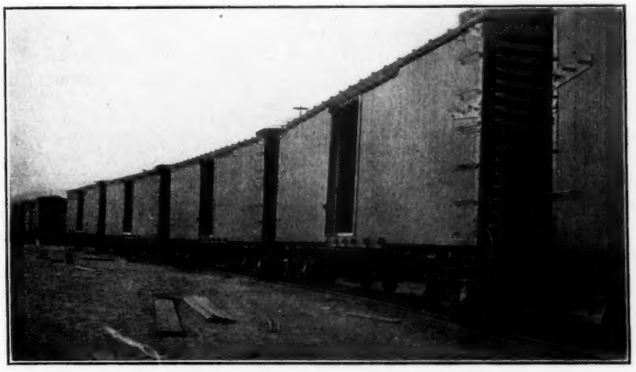


Fig. 2—A String of Steel Underframe Cars After Rebuilding

wood box cars was taken up. These cars required new side sills, plates, posts, decking, all siding, etc. In fact, they were built entirely new from the sills up, with an inside metal roof. (See Fig. 1.) Seven hours was set as a schedule, with eight operations and a total of twenty-seven men, and this work was done at an average labor cost of $45.36 per car. Then followed the rebuilding of a series of 100 steel underframe box cars, shown in Fig. 2, which were put through on a six hour schedule. These schedules were

rigidly maintained, and a number of workmen were weeded out as the work progressed on account of not keeping up with the procession.

Routing Cars and Material

A word as to how the work was kept moving. All heavy work of this kind on which a schedule can be successfully

Fig. 3—A Badly Bent Sheet in the Flanging Clamp

used is laid out on repair tracks which open on a transfer table on one end and to the repair track lead on the other. The cars are brought in over the transfer table and started

Fig. 4—The Sheet Shown Above Fifteen Minutes Later

down the track. When the first operation is completed, the men move the car ahead one car length, and so on down the track until all operations are finished, when the switch engine removes the cars from the track and takes them to the paint track where painting and stenciling is done. The material used in each operation is conveniently placed for the gang on that operation to reach.

The secret of the success of the schedule plan lies in the fact that each man performs only one operation, and that one over and over again. As he gains experience and practice in performing that operation he begins to try to make it easier to perform, knowing that as he succeeds in doing so he also makes the work easier for himself, thus, unconsciously, speeding up the machine as a whole. The necessity of teaching a workman one operation only makes possible the use of inexperienced men on practically the entire job. Another gain made is that the different gangs will unconsciously promote rivalry by the exercise of that pride that exists in almost every man of not letting the other fellow beat him, thus each gang striving not to be last really keeps the whole moving smartly and rapidly. The schedule plan also helps out the labor situation in this day of shortage of mechanics, as it is our practice to use the experienced men

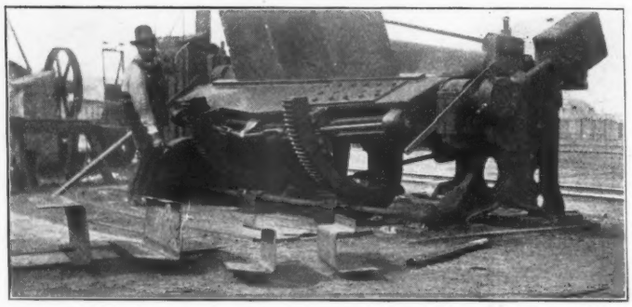


Fig. 5—Flanging a Floor Sheet in the Power Brake

on light or running repairs, and the less capable men on the work which can be placed on a schedule as just outlined.

Steel Car Repairs

The subject of heavy steel car repairs seems to be sidestepped by most of the car men who write for technical magazines, not because of its lack of importance for this is the most important work of the car department. Perhaps the subject can best be handled by giving a general description of some of the most important points. For instance, a side sheet of a gondola car is often badly bent and possibly rolled up by being cornered or wrecked. Experience has shown that the only way to handle a case of this kind is either to take out the entire sheet and straighten it cold on a face plate with clamps, or else cut out the damaged

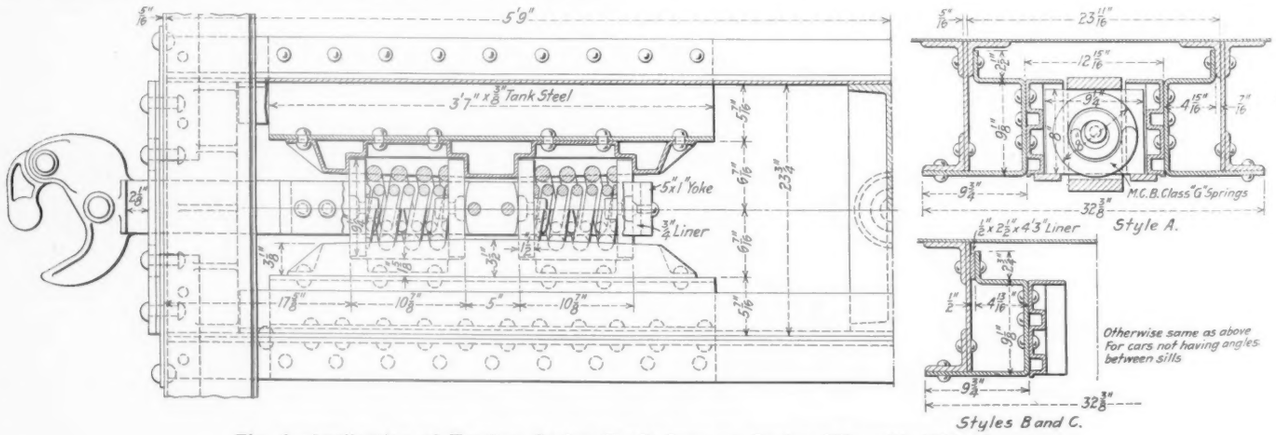


Fig. 6—Application of Tandem Spring Draft Gear on Center Sills with Wide Spacing

portion and put in a new piece by making a butt splice.

In any case when attempting to straighten plate steel such as is used in the floors, sides, and ends of a gondola car, *do*

not attempt to use heating appliances such as oil burners and torches, as the trouble will only be aggravated. These plates must be straightened cold on face plates, and by the use of powerful clamps, aided by a libeal use of hand power in the shape of heavy sledges. In Fig. 3 is shown

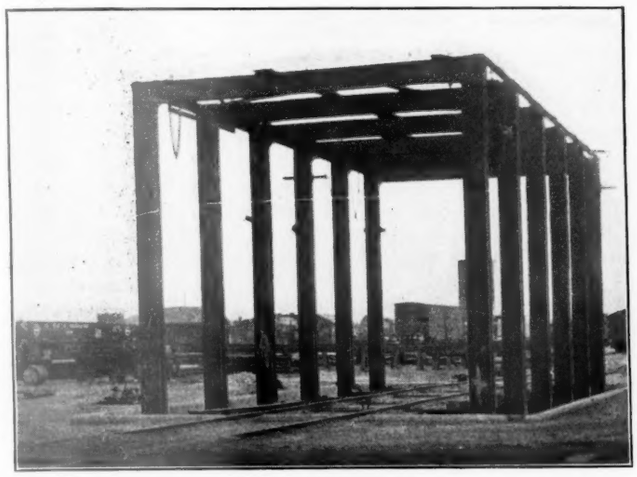


Fig. 7—Jacking Stall for Straightening Steel Cars

a clamp in use to straighten all parts of steel cars. This is in reality nothing but a boiler shop flanging clamp.

The photograph shows a badly bent side sheet of a gondola car in position in the clamp for straightening cold. Fig. 4 shows the same plate 15 min. later, having been straightened by the clamp, and three men with sledges, in that period of time.

In Fig. 5 is shown a bending brake on which it is possible to bend cold, to any desired shape, plate steel up to ¼ in. in thickness by 10 ft. long. In the foreground may be seen various shapes which have been formed cold on this machine. It has been found to be of great benefit in our steel car work. In the illustration the machine is shown in operation forming a floor sheet for a 40 ton steel gondola car, which is being put through the shop for new floors, the old floors being corroded and rusted through. In connection with renewing the floors in these cars it was found that the side sheets were also rusted through at a point just above side sill. In order to avoid applying new side sheets we used plate steel wide enough to flange upward on the side sheet

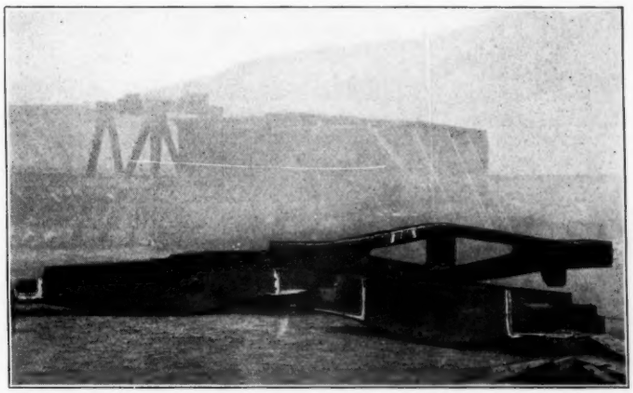


Fig. 9—Defective Bolsters Prepared for Welding

16 in. from the top of the side sill and riveted to the side sheet by a row of ½ in. rivets spaced 6 in. apart. This makes a very neat job, and also makes the side sheets just as good as new ones, as corrosion of the side sheets does not extend more than 6 in. above the side sill.

These cars were built in 1903 and the center sills were

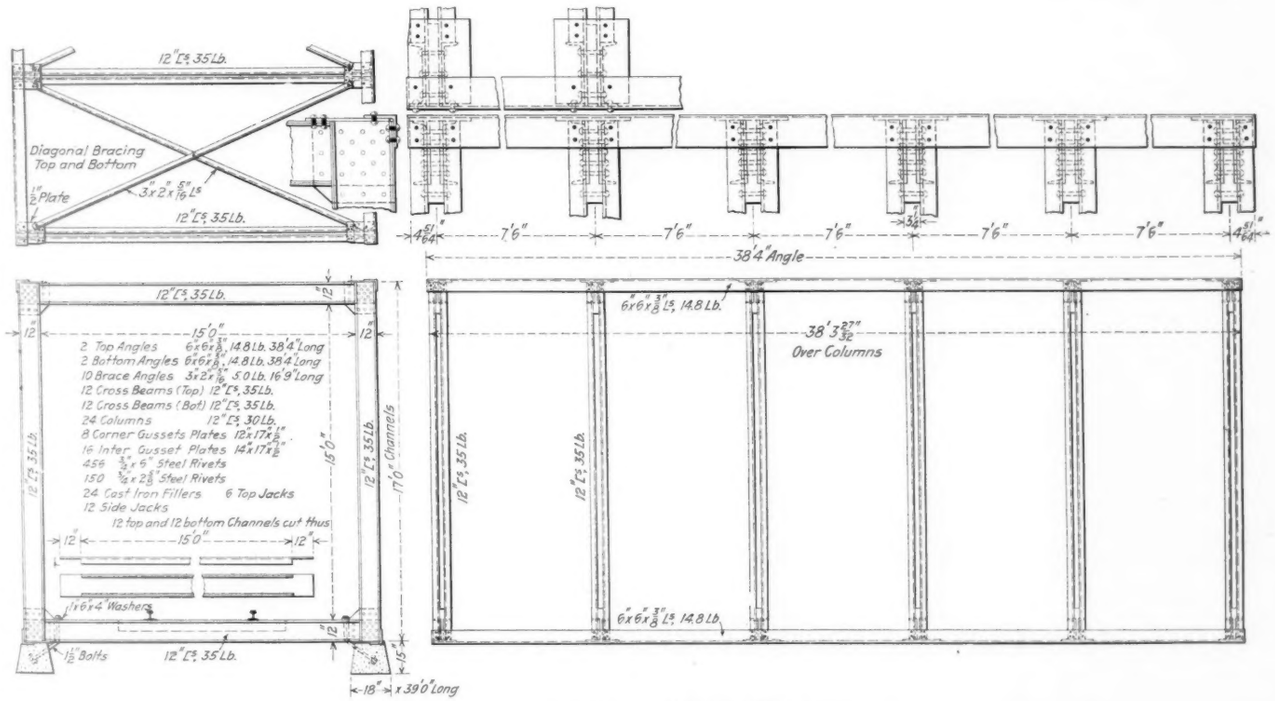

12" Lʳˢ, 35 Lb.
Diagonal Bracing Top and Bottom
1" Plate
3"x2"x 5/16" Ls
12" Lʳˢ, 35 Lb.
7'6"
38'4" Angle
2 Top Angles 6"x6"x 3/8", 14.8 Lb. 38'4" Long
2 Bottom Angles 6"x6"x 3/8", 14.8 Lb. 38'4" Long
10 Brace Angles 3"x2"x 5/16", 5.0 Lb. 16'9" Long
12 Cross Beams (Top) 12" Lʳˢ, 35 Lb.
12 Cross Beams (Bot) 12" Lʳˢ, 35 Lb.
24 Columns 12" Lʳˢ, 30 Lb.
8 Corner Gussets Plates 12"x17"x 5/16"
16 Inter. Gusset Plates 14"x17"x 5/16"
456 3/4"x 6" Steel Rivets
150 3/4"x 2 3/8" Steel Rivets
24 Cast Iron Fillers 6 Top Jacks
12 Side Jacks
12 top and 12 bottom Channels cut thus
15'0"
6"x6"x 3/8" Ls, 14.8 Lb.
38'3 27/32" Over Columns
1/16"x4" Washers
1½" Bolts
18" x 39'0" Long

Fig. 8—Construction of the Jacking Frame

spaced 24 in. apart, and equipped with a twin spring draft attachment which was continually failing. To overcome this trouble it was decided to change the draft gear to the tandem spring type using the heavy type G spring. This was accomplished by applying a cheek plate made from ⅜ in. steel, as shown by Fig. 6. This has proved very satisfactory, and stopped draft gear trouble with this series of cars.

Frequently steel, or steel underframe, cars are found with

the center construction badly out of line, or the sides badly buckled. These cars are taken to the jacking frame, Figs. 7 and 8, where they are readily straightened without stripping. This frame can be constructed at a nominal cost, and will soon pay for itself in the economies effected. Jacks may be used at any angle desired, and from as many different angles, simultaneously, as one may see fit.

Some of the work done with the oxy-acetylene welding plant is shown in Fig. 9. Built up truck bolsters on which the ends have been worn through, are shown in the foreground. Enough of the bolster is cut out to remove all the worn parts, then new metal cut to fit the original contour

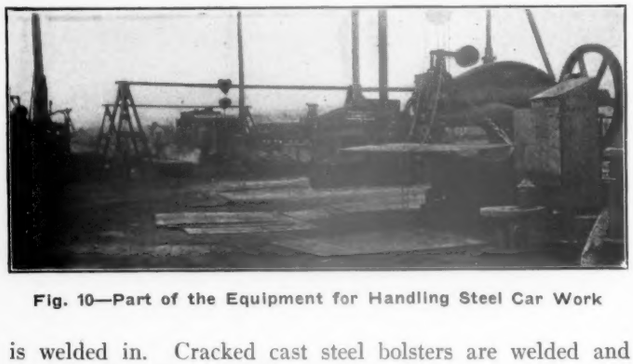


Fig. 10—Part of the Equipment for Handling Steel Car Work

is welded in. Cracked cast steel bolsters are welded and then patched over the weld.

A part of our steel car fabricating machinery, forges, and face plates used in repairing steel car detail parts are shown in Fig. 10. Fig. 11 shows the nature of some of our steel car repairs.

Keeping the Output Up

The car plant, as reviewed in this article, and shown in the cuts, is capable of handling all repairs and rebuilding, as well as building new any equipment that might be needed on a road of the size of the E. P. & S. W., if efficiently handled, and efficiency is a matter that our supervisory forces must become more proficient in than ever in these days when mechanics are made by an order and perpetuated by an agreement. We must use every endeavor to get every return

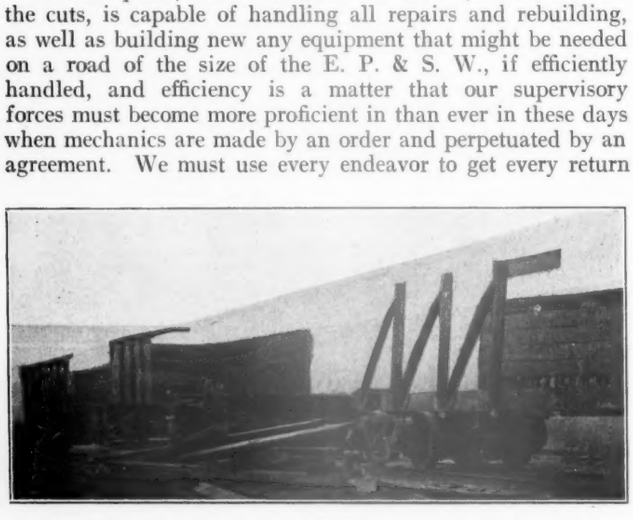


Fig. 11—Steel Cars Dismantled for Repairing

possible for the money spent for labor, ever remembering that any force of men will give results in direct proportion to the desires of their supervisors, and that, if any of our shop forces are not up to the standard output, or unit cost, the trouble is in their supervision, or something that the supervisor can correct. Do not put up that excuse which of late has become so popular, "The men will not do a day's work any more," but instead ask yourselves the question *why* they will not, and then proceed with the remedy. If the remedy is bitter, take it in small doses until you have effected a permanent cure, or else acknowledge to yourself that you are out of place as a supervisor and retire to a sphere where you are on common ground with your surroundings.

If above the need of a remedy, or having taken it, and are yourselves above reproach along these lines, then unite in condemning to your superiors the past practice of car construction to the end that future equipment may be constructed strongly and correctly, then protected from shocks by some improved shock absorbing device, instead of as in the past when the theory of constructing the different parts stronger each time new cars were built was followed so far that as a result at the beginning of government control we were constructing cars on the theory of a battering ram wherein the stronger destroys the weaker, and the poor car man was blamed for not keeping his equipment in service instead of requiring those responsible for design to properly design and *provide protection* from the shocks and rough handling they, as well as all of us, knew the car would receive when placed in service.

The thousands of cars built prior to about 1912 and put in service without any means being taken to protect them from the shocks it was known they would receive stand as a monument to prove that our practice has been wrong in the past, and our ways should be mended at once. We should take some of the remedy called "self analysis," and may possibly derive some benefit from a consistent course of this treatment.

PERIODICAL REPACKING OF JOURNAL BOXES A.R.A. RULE 66

BY CAR INSPECTOR

Numerous papers have been written on the subject of hot boxes, the causes and remedies therefor, and various methods of packing journal boxes have been introduced, but nothing has been offered which will eliminate the trouble entirely. Just as soon as an epidemic of hot boxes appears and trains are seriously delayed everyone on the railroad, from the president down, gets busy and the trouble is temporarily relieved. This would indicate that careful attention as to repacking and lubricating is necessary at all times. It has been clearly demonstrated that unless journal boxes are properly packed journals will not lubricate, resulting in heating of the brass. If not detected in the early stages of heating, the journal as well as the brass, wedge and in many cases the journal box also will be damaged to such an extent as to require renewal. An important duty rests upon the shoulders of the car oiler and just how well he performs his work can be very readily judged by glancing over the hot box reports.

Too much of the work of administering care to journal boxes has been left to the car oiler in the train yards and not enough attention given this class of work on repair tracks and in shops. M. C. B. Rule 1 requiring that the same attention be given foreign cars as the owner's cars has not been fully carried out in this respect and the fact that cars are away from home ofttimes two and even three years, renders necessary some action which will assure better attention for the foreign car. A. R. A. Rule 66 which makes the car owner responsible for periodical repacking of the journal boxes should be an inducement to care for the foreign car and if the work is properly performed in accordance with the provisions of this rule there is no question but what a remarkable improvement in the condition of journal box packing will be noted. It should be borne in mind, however, that the results which will be obtained, depend entirely upon the manner in which the work is done and the supervising force in the car department has an important duty to perform in carrying out the provisions of this rule. The practical value of all A. R. A. rules can be greatly enhanced by more care in living up to them.

THE INSPECTION OF FREIGHT EQUIPMENT*

Air Brakes and Foundation Brake Rigging; Estimated Braking Power; Defects of Arch Bars and Trucks

By L. K. SILLCOX
Master Car Builder, Chicago, Milwaukee & St, Paul

TO PIPE cars properly is of vital importance to the desired action of the air brake. This, however, is a portion of the air brake make up which is occasionally neglected. Under no condition should the pipe be used without first being thoroughly cleaned. To do this the pipe should be lightly tapped to loosen the scale and dirt and then be blown out with steam or air. The sizes of pipe given in the air brake catalogues should in all cases be strictly adhered to. It will be noted that sizes of pipe given for freight cars are generally larger than those to be used on passenger coaches, as shown below. This is for several reasons.

(1) It will cause a more rapid reduction or increase of pressure at the rear portion of the train on account of air traveling through the large pipe more quickly; the larger the pipe the less friction the air will encounter in its passage through it.

(2) A freight car is considerably shorter than a passenger car, thus the large pipe makes the volume of air in the train more nearly equal to that in the smaller pipe used on the passenger coaches, which are longer.

When pipes are cut a flare or fin will be created in the inside of the pipe, considerably reducing its size; this in all cases should be carefully removed with a reamer. When too many of these are allowed to remain through the pipe system it will prevent the emergency action of the brakes. When using red lead or any other substance to make a joint, it should always be put on the outside thread or the thread to be screwed in, as this will prevent it from being forced into the pipe and causing defects in the brake system.

Whenever practicable, when necessary to change the direction of the pipe, it should be done by long, easy bends, instead of elbows or short bends, as the frictional resistance caused by these fittings retards the flow of air through the pipes. Care should be taken to have all the pipes rigidly clamped, so as to prevent vibration or moving, which causes the joints to leak or holes to become chafed in the pipes. After the pipe work is applied and completed it should be thoroughly tested under full pressure for leaks by use of soap suds applied to the joints, and later painted with rust-proof paint.

Cars will not be accepted in interchange unless equipped with air brakes having 1¼-in. air brake pipe and angle cocks, also quick action triple valve, pressure-retaining valve and an efficient hand brake.

Pipe Clamps

Pipe clamps should be checked at every opportunity both on repair tracks and in yards, to see that they are so placed and in the necessary condition to perform the work for which they were intended. They should be securely fastened to a rigid part of the car and should hold the piping firmly, prevent vibration and not allow the brake pipe to shift lengthwise if air hose are pulled apart, as happens in a break in two or when switching in the yards. Any missing jam or lock nuts must be replaced.

Air Hose

It is required that all air hose must be tested under air pressure with soap suds at every available opportunity whenever air pressure is to be had. This practically only applies to repair tracks, but much difficulty is experienced in the outside yards where a soap suds test is not practical, and therefore defective hose is hard to locate. Inspectors should be very careful in their inspection of hose on cars in the yards and should remove every one that shows an older date than 27 mo. if they do not consider it safe to proceed, and of course this only applies to hose which otherwise appear to be in good condition. Any of these hose that are removed on account of being old date should be forwarded to the main shop in the district so that they may be properly tested.

It should also be the duty of all inspectors to pick up all defective hose, regardless of the nature of the defect, and forward them to the general storekeeper. A great many of these defective hose, especially burst hose, will be found in cars and cabooses, and inspectors should make a periodical inspection of this equipment, so that they may know positively that there is no defective hose lying loose in their district.

At No. 1 and No. 2 inspection stations air hose must be tested with soap suds, and if found in a porous condition is to be replaced. Air hose gaskets must be kept in good condition, and when new ones are inserted the retaining groove must be cleaned out with the tool provided for that purpose. The opposite end of this tool, which is formed in a loop, is to be employed in seating the gasket in place. Air hose in service more than 27 mo. are generally in need of replacement.

Brake Cylinders and Reservoirs Loose on Their Supports

Whenever indications point to a cylinder and reservoirs being loose on their supports, or if any of the cylinder or reservoir bolts are loose or gone or lock nuts needed, repairs must be made at once, as movement of these parts causes brake pipe leakage and breakage. When brake cylinders and reservoirs are to be tightened on their supports, run up two or three of the nuts only far enough to bring the bolting flange into light contact with the supports. Then, with the bolting flange in contact with the supporting brackets at each hole, line up with cut washers where required. A failure to do this will result in springing and cracking the auxiliary reservoir and springing brake cylinders out of round.

A great deal of difficulty is experienced on account of reservoirs breaking away from cylinders and holding brackets on cylinders and reservoirs breaking off. While the class of supports used on many cars in service is at fault, the majority of the difficulty which is being experienced could be overcome if a little more care were taken in drawing up the nuts of the supporting bolts. It is common to see the men draw the nuts up until the cylinder and reservoir are in full contact with the support, thereby bringing an undue strain on the equipment. If where the supports are out of alinement the carmen were instructed, before tightening the nuts, to merely draw the reservoir up until the bolting flange was in light contact with the support and then line up with cut washers whenever necessary, the danger of breakage would be lessened considerably.

Triple Valves

There are six types of triple valves in general service, namely the Westinghouse, H-1, H-2, K-1 and K-2 and the New York F-1 and H-2. All of these valves work in con-

* Fifth of a series of articles on this subject by Mr. Sillcox. Copyright 1920 by the Simmons-Boardman Publishing Co.

junction with one another and are interchangeable to the extent that the H-2 Westinghouse and New York can be applied to a car that formerly had the K-2, but the H-1 Westinghouse and F-1 New York could not be used in this instance as one is a ten-inch valve and the other is an eight-inch valve. Otherwise there is no difference in the working of the valve.

Brake Rigging

Brake heads and brake shoes should be carefully inspected to see that they are in good condition and keys properly in place. Should brake shoes be worn out at either end permitting the head to wear against the wheels, the brake shoes should be renewed. When brake shoes are worn irregularly they should be reversed to obtain the maximum service from the metal in the shoe.

Brake hangers should be inspected at the brake head to see that they are not worn, making them unsafe; this should also apply to the hanger at the truck connection, to see that the hook or eye are not worn to the unsafe limit. Brake wheels, brake ratchet wheels and brake ratchet pawls should be inspected to see that they are properly retained in place when repairs are being made and careful inspection is to be made to see that they are properly maintained. Bolts and pins used in connection with hand brakes should be in place and properly secured.

Adjusting Brakes

After checking up piston travel if it is found necessary to re-adjust the brakes, the first thing to be done is to close the cut-out cock in the crossover pipe and bleed the auxiliary reservoir, this to prevent injury. The adjustments must be made so that the live truck levers on both sides of the car travel the same distance, to insure an equal distribution of braking power. With the brake applied, the foundation brake rigging should be inspected to see that all levers have ample clearance in their guides and elsewhere to prevent striking or binding with 12 in. piston travel, that all cotter keys are in place and points well spread, that hangers and dead letter fulcrums are secure, that the brake levers are standard, that rods are not being cut by axles, and that the rigging in general is in good order.

Before making any changes to provide lever clearance, insure that the length of rods and guides and the location of the latter are standard for the car. Whenever inspecting cars, inspectors must make sure that the brake rods are not riding on the axles thereby making them liable to break on application of the brakes.

Piston Travel

By piston travel is meant the distance the brake cylinder piston moves out when the brake is fully applied. To measure piston travel first be sure that the head is bottomed in the cylinder, making a mark on the piston rod at the edge of the cylinder head and then note the distance the piston travels out when the brakes are applied. Standing travel is the distance the piston is forced out in an application of the brake upon a car when not in motion. Running travel is the distance the piston is forced out in applying the brake upon a car when in motion. The running travel is always greater than the standing travel, the increase due to slack in loose fitting brasses, to the shoes pulling down on the wheels, to play between boxes and pedestals and to everything of a similar nature that increases lost motion in the brake rigging under the influence of the motion of the car. False travel is an excessive travel momentarily occurring while the car is in motion. It is due to unevenness of the track or to some unusual temporary strain.

The brake cylinder pressure resulting from a common train pipe reduction is greater with a short than with a long piston travel. A piston travel of eight inches results in a brake cylinder pressure of about 50 lb. in a full service application. Inasmuch as running travel is generally about 1½ in. greater than standing travel, the standing travel should be 6½ in. to secure this result while running. If the piston travel is shorter than eight inches, the auxiliary and brake cylinder air will equalize at a higher pressure and the brakes will be applied much harder. If the travel is more than eight inches, the auxiliary and brake cylinder air will equalize at a lower pressure and the brakes cannot be applied nearly as hard.

Brake Leverage

Ability to figure brake leverage is an accomplishment for an air brake man, not always a necessity, but it is well to know something about it. The different kinds of levers and the manner in which they operate should be learned first. A lever of the first kind has the power applied at one end, the weight to be moved at the other end and the fulcrum in the center. The cylinder lever connected to the push rod and top rod is a lever of the first kind.

A lever of the second kind has the power applied at one end, the fulcrum at the other end and the weight to be moved is between them. The live truck lever of an outside hung brake is usually a lever of this kind.

A lever of the third kind has the power applied between the ends. A lever of this kind takes more power in proportion to the weight to be moved than either of the other kinds. This lever is very rarely met with in the present construction of freight cars.

When measurements and calculations of brake power are made, the greatest care must be exercised in measuring, as a mistake of a very short distance on the short end of a live lever will alter the power considerably.

Beginning at the brake cylinder where the power is first exerted, the power must be ascertained, which is done by multiplying the area of the cylinder piston by the pressure per square inch. The result of an eighth-inch cylinder is 2,500 lb. and a ten-inch cylinder, 3,900 lb. This value is then multiplied by the distance from the push-rod connection to the fulcrum, which is in the center, this lever being of the first kind, and this product is divided by the distance from the fulcrum to the top-rod connection. This will give the pull on the top road, which is transmitted to the top of the live truck lever, usually a lever of the second kind. This pull is next multiplied by the total length of the live truck lever and the product is divided by the length of the short end, which will give the strain on the brake beam. This multiplied by the number of beams will give the total braking power. To determine what per cent the car is braking the total braking power is divided by the light weight of the car. Cabooses should brake approximately 45 per cent of their light weight, other freight cars 60 per cent.

Both cylinder levers, or cylinder and floating lever, need not be of the same length, but they must be of the same proportion to insure getting the same braking power on both ends of the car.

Brake Levers

When necessary to apply a new lever to a system freight car the proper dimensions of the lever wanted must be ascertained positively in order to provide the proper braking force to the wheels. The dimensions of the various levers for the several types of cars are clearly shown on blueprints and must be closely followed.

Lever Pins and Cotter Keys

The greatest care should be exercised at all times to know that lever pins are properly in place and cotter keys applied and properly opened to prevent the pin being jarred out, which would cause a brake rigging failure and probably a derailment, especially if it occurs in the bottom rods. Lever

pins should be placed in from the top whenever possible, as this will provide a certain amount of protection in case the cotter key works out. Brake beam hanger pins also should be checked over closely to ascertain whether the pin by continual friction is worn through and liable to break at any time. It would be good policy, whenever possible, to have brake hanger pins removed for inspection, as investigations disclose the fact that a great majority are about half worn through. At any rate, inspectors and repair men should check them very closely, as there is nothing that tends more to cause derailments than brake beams coming down.

Cotter Pins, Split Keys and Nuts of Brake Hanger and Connection Bins

It should be remembered that these parts must be placed with the heads inside or under, so as to make the retaining cotter pin, split key or nut visible from a passing inspection, and not make it necessary for inspectors to climb under the car to note their condition.

Brake Beams

The dimensions and proportions governing the hanging of brake beams are as follows: The height when measured from the top of the rail to the center of the face of new shoes is: For inside hung brake beams, 13 in.; for outside hung brake beams, 14½ in.

The spacing from center to center of brake heads is 60 in., with an allowable variation of ⅛ in. in either direction. Attachments for safety hangers shall be 51 in. from center to center.

The angle of the lever fulcrum shall be 40 degrees from the vertical.

The lever pin hole shall be either two or three inches in front of the top of the brake head lugs. The variation in either direction from straight and true shall be not less than 1-3/32 in., nor more than 1⅛ in. in diameter.

Safety Hangers

It is required that all brake beam safety straps on car trucks shall be of such depth as to allow but ¾ in. between the straps and the bottom of the brake beam when the brake shoe is ⅜ in. from the wheel, and of such length that no part of the brake beam will strike the strap when the brake is applied with all shoes worn to a minimum thickness. It is also required where angle iron brake beam safety supports are employed that not to exceed ¾ in. clearance is to prevail between the bottom of the brake beam and the top side of the safety angle.

The capacity and strength of the number one beam is suitable for cars weighing less than 35,000 lb. The number two beam to be used on cars weighing over 35,000 lb., although it is permissible to use the number two beam on cars weighing less than 35,000 lb. Right and left-hand brake beams are designated as follows: When facing the back of the brake beam with the center strut pointing away from the observer, if the top of the lever slot inclines toward the right it is known as a right-hand beam, and if the top of the lever slot inclines toward the left it is known as a left-hand beam.

Brake Shoes

It should be borne in mind that at each application of new brake shoes the piston travel changes. Therefore, whenever new shoes are applied to cars the piston travel should be checked up accordingly.

Hand Brakes

In checking up cars before leaving repair tracks and yards, it should be known that all hand brakes are released, for if cars are allowed to leave with the hand brake set there is a liability of slid flat wheels, or at any rate overheated wheels, and the eventual possibility of bursting. Also, it should be noted that the hand brake rod and chain are not too long. They should be of such dimensions as to insure a full application of the brakes with the use of the hand wheel. The chain must not catch on the staff support and rods, levers, etc., and must be free from any interference that would prevent the delivery of full hand brake force to the brake shoes. Brake chains or rods must not bear against any part of the axle, causing chafing and wear.

Hand Brake Staffs

Hand brake staffs must be made of one piece; welding of two or more parts together is not permitted. The standard maximum height of the brake staff for standard box cars, from the top of the rail to the top of the brake staff, is 14 ft. The portion of the brake staff on which the brake chain winds must be of such length and so located as to permit winding the amount of chain resulting from 12-in. piston travel without "piling up" or overlapping.

The dimensions of the brake chains should be, for the first link that fastens on brake staff, ½ in. diameter, 2 in. long, and 13/16 in. wide inside. For the succeeding links, 7/16 in. diameter, 1¼ in. long and ⅝ in. wide inside measurements. This chain is attached to the brake staff with a ½-in. bolt, which is riveted over after the nut is applied.

Hand brakes must be known at all times to be operative and effective; a failure of this appliance constitutes a violation of the federal laws, therefore proper inspection and maintenance are absolutely necessary.

Running Repairs to Trucks

It seems to be the general experience that there is a great deal of trouble, due to failures of truck frames on account of nuts missing from box pedestal jaw and column bolts, and in many cases it is necessary to apply new bolts on account of the worn or otherwise damaged condition of the threads. It is also found that on practically all types of trucks a great many brake hanger bolts and pins are found that have no spring cotters, split keys or nuts to hold the bolts or pins in place, the result being that the bolts or pins fall out of the hangers and allow the brakebeams to drop; also, the hangers and pins are allowed to become worn to such an extent that in their weakened condition they fail. Care must be exercised in examining brake hangers to see that flaws in forgings do not exist, also that the brake heads are not worn beyond the required limits.

Another point is that a large percentage of the brakebeams in service have no safety device for holding them in case the hanger or pin should break, with the result that it is found necessary to employ extra men in the yards to watch these important features of truck inspection and maintenance. On account of the great amount of this work in large terminals, it appears that generally some stations are not giving all the attention that they can to maintaining these essential parts of trucks while passing through their hands, the result being that extra work is placed upon their neighbors.

The matter of truck maintenance should be taken up vigorously by all supervisors and the attention of inspectors and repairmen called to seeing to it that the nuts on oil box, pedestal jaw and column bolts are all applied and kept tight and also that the brake hanger bolts or pins are equipped with a suitable lock nut, spring cotter or split key. The failure of these parts is causing much trouble, and no reasonable expense should be spared in properly maintaining them.

Investigations carried on from time to time have developed that after the removal of brake hangers and pins from a number of cars they were found to be about half worn through. It is apparent that these parts have been in service for a long time and that they are very rarely, if ever, inspected except when brakebeams or hangers fail. It is a paying practice, whenever cars reach repair tracks, to have all the brake hanger pins and bolts removed for inspection and renewed when found necessary.

With this end in view, therefore, a system should be in-

augurated at all stations whereby all cars reaching repair tracks will have the trucks carefully locked over and the renewal made of any parts showing undue wear. Particular attention should be given to the column and oil box bolts and nuts—in fact, it should be our purpose not to allow any car to leave a repair track without the trucks receiving a thorough going-over and being put in good repair.

For system cars the standard brakebeams furnished are equipped with three openings, namely, for the pot hook hanger, for the intermediate stirrup type hanger and for the center supervision hanger, with the thought that the brake hanger can be changed in case the pot hook eye is worn, thus avoiding the necessity of having to change the entire brakebeam. It is further desirable to see that nuts on tension rods of brakebeams are kept properly locked in place and tightened.

Defective Arch Bars and Truck Frames. — Permissible Methods of Welding and Repairing.—Arch bars should be inspected for cracks, especially in bends. This may be more effective after first giving the edge of the arch bar several taps with the inspector's hammer to loosen up rust at cracks and flaws, which can then be more readily detected. Seams and flaws are usually found at the bends and at column bolt holes, especially at the bottom of the column post on the edge of the arch bar. Arch bars should not be welded in the bend or at bolt holes or between the journal box or column and box bolt holes. Trucks with cast steel side frames, such as Bettendorf, Andrews, Vulcan, Scullan, Ajax and others, should be gone over carefully to discover flaws or cracks that might exist which would endanger their safety. The same tapping with the hammer as on arch bars should be required on cast steel side frames. These frames are not considered safe for service when found cracked or with flaws more than *one inch back from the edge of the frame.* Such frames should be repaired by welding with oxy-acetylene or with electric welding apparatus, or they should be replaced with a new casting.

The fact that so many cast steel side frames and cast steel bolsters are failing in the tension (lower length of the truss) members is conclusive evidence of weakness in design, and the welding of the fractures will not add to the strength but is likely to introduce a condition of further weakness by improper workmanship and change in the structure of the metal. It is, therefore, necessary to confine acetylene or electric welding within specified limits on structures, subject to alternating stresses, as experienced in truck side frames and bolsters. The parts which are to be repaired must not be welded unless removed from the car or truck. Truck bolsters, however, may be welded in place by removing the truck from under the car body. The entire crack should be burned or chipped out far enough back so that there will be no portion of the crack in the metal. Failure to do this permits the check or crack to work its way across the metal to the farther side, due to the constant vibration, even after the weld has been made. A hole may be drilled at the end of the crack or check and chipped or burned towards the hole. The surfaces where new material is to be deposited must be clean and bright and reasonably smooth, and therefore if surfaces are prepared by the burning process the surfaces must be finished by chipping or welding. The portion of the part adjacent to the fracture should be heated before the welding is begun. In welding, the operator should begin to weld at the point farthest away from the outside edge and work the weld towards the edge. When truck sides and bolsters are welded, the weld must be made smooth and the following record legibly stamped on the weld with at least 3/8-in. steel stencils in the following form:

No..... Day..... Year..... Road.....
Shop Symbol..... Welders No.....

Truck bolsters and spring beams should be carefully inspected to see that they are secured to place properly and are not cracked or broken, making them unsafe for service.

Arch Bars and Truck Frames Bent

Derailments and other classes of road failures often cause trucks to be allowed to go into service temporarily with arch bars and frames bent laterally in the center; this is not only dangerous but a regrettable practice.

Side Bearing Clearance

Side bearing clearance should be carefully observed on cars with metal body and truck bolsters. When balanced on center plates it is considered good practice to have clearance of 1/16 in. to 1/8 in. between all four side bearings. If they are bearing hard on one side the total clearance should not be more than 1/4 in. on the opposite side. On cars with wood body and truck bolsters, or composite wood and metal bolsters, it is considered good practice to have 1/8 in. to 1/4 in. clearance between all four side bearings.

Care of Journal Box Lids

Lids on journal boxes should be lifted to make inspection of the sponging, journal bearings and journal bearing wedges to see that they are in proper condition, and journals not cut. Journal bearings and wedges should be in proper position in the box and sponging in place well to the back of the box and up under the journal. Box lids should fit well in place and be properly secured to exclude dirt and dust.

Truck Brake Rigging

Brakebeams, brakebeam connections and brake hangers should be carefully inspected to see that they are in good condition, with brake connection pins in place and cotter or split keys properly applied and opened. Brake levers and lower brake connecting rods are to be inspected to see that they are in good condition and the brake pin cotters split.

Brake heads and brake shoes should be carefully inspected to see that they are in good condition and the keys properly in place. Should brake shoes be worn out at either end permitting the head to wear against the wheels, the brake shoes should be renewed. When brake shoes are worn irregularly they should be reversed to obtain the maximum service of metal in the shoe.

Brake hangers should be inspected at the brake head to see that they are not worn, making them unsafe; this should also apply to the hanger at the truck connection, to see that the hook or eye are not worn to the unsafe limit. Brake shoes which are broken away or not safe must be replaced, and shoes unevenly worn must be turned. Brake shoes must be properly located and in place and not allowed to ride on the flange of the wheel. Brake shoes showing signs of being burnt red must have the brakes on such cars tested for proper operation and wheels examined for heating cracks.

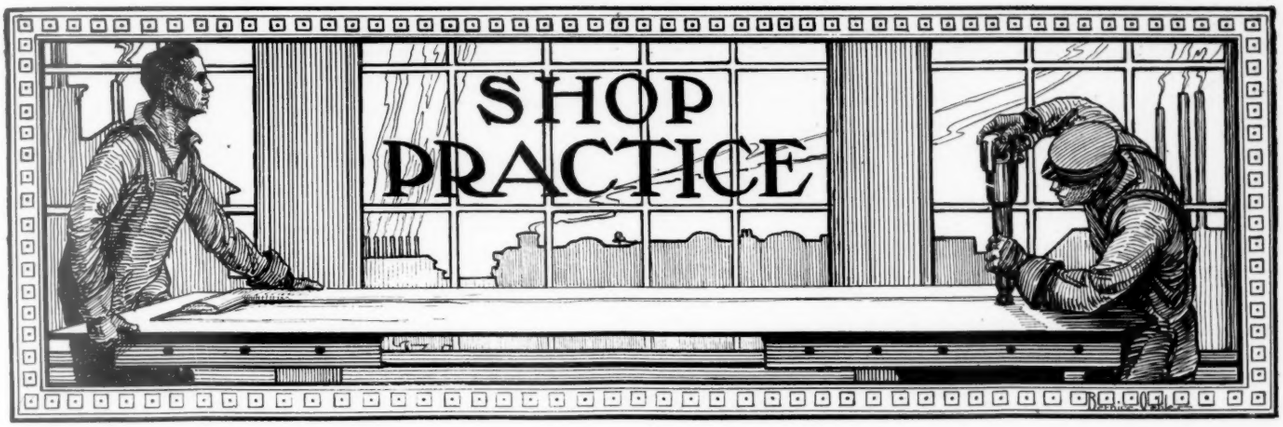
Hand brakes should be tested to see that they are in operative condition and the brake chains not too long to prevent fouling when brakes are applied. Brake chain links should not be less than 3/8 in. in diameter at any point.

The brake wheel, brake ratchet wheel and brake ratchet pawl should be inspected to see that they are properly retained in place when repairs are being made, and careful inspection is to be made to see that they are properly maintained.

Cars built after October 1, 1914, and prior to January 1, 1917, will not be accepted in interchange unless equipped with either the No. 1 or the No. 2 M. C. B. brakebeam, as indicated by the light weight of the car; the No. 1 beam must not be used on cars having a light weight in excess of 35,000 lb. Cars built after January 1, 1917, or cars receiving general repairs after October 1, 1918, must be equipped with metal brakebeams of not less than the capacity of the No. 2 M. C. B., or stronger, as the conditions may require.

All of the M. C. B. brakebeams referred to shall have the letters "M. C. B." and proper number plainly stamped or cast on the strut, as required by the specification.

After October 1, 1920, cars will not be accepted in interchange unless equipped with all metal brakebeams.



SHOP SCHEDULING VS. OLD-FASHIONED METHODS

BY SUPERVISOR

The question is often asked, "What is the difference between running a locomotive repair shop with a schedule system or in the regular way as usually done?" It may be answered as follows:

The old-fashioned method of getting output from a railroad shop was to bring in engines until the shop was as full as possible. In a transverse shop with 25 stalls, two small engines were placed on some stalls, blocking or cramping the passage ways at the front and rear of other engines, crowding in, say 35 engines. In a longitudinal shop with accommodations for 25 engines on two outside tracks, five or six engines would be put on the central or wheeling and transfer track, blocking the passage of wheels and engines going out. Also engines are crowded in so closely together on all three tracks that spaces between them are narrowed or closed entirely. Probably there would be 35 engines in this shop also.

Shop men frequently complain that locomotive output is limited because of a lack of pits. The author of this article thinks the fault lies elsewhere.

The next step was to date the completed engines out and begin repairing those shown to go out first. Soon a cylinder is wanted, or a steel deck casting, or some unusual part, and these are not found in stock. This engine is then abandoned for the time being and the men are told that another more promising engine will come ahead and all hands go to that engine, transferring tools, material, etc., and they all take plenty of time to make notes and begin over again, studying the needs of this new engine. Material must be hunted up, and in some cases material from the first engine which is bolted to the lathe or planer is taken off and other material for the second engine substituted. Perhaps another switch is made from this second engine on account of delayed material, a welded frame tongue in the smith shop, a new link in the machine shop or heavy boiler work develops. In like manner possibly every other engine in the 35 undergoes a similar process of being worked on for a while and later deserted.

To sum up the situation, the unsystematic, inefficient shop superintendent gets what he can out of his shop, full to overflowing with engines and material. The men and supervision are demoralized. There is no penalty except tempestuous talk and driving for not getting an engine out on the date set; simply pick another good one and get that. The higher officers are continually disappointed; they expect a certain engine out on a stated date and don't get it. This old-fashioned organization with 35 engines on 25 pits in the shop finally succeeds in delivering 25 engines with classified repairs by the end of the month. This means an output of one engine per pit per month, or, based on 35 crowded pits, 7-10 of an engine per pit per month.

Now a railroad repair shop is, or should be, as carefully designed as a Mallet engine. A Mallet will give its maximum drawbar pull with minimum steam consumption, at a working speed of about 15 miles per hour. Likewise a modern railroad shop will, at the present time, deliver its maximum output at the rate of about two engines per pit per month, with minimum cost and minimum labor and machine effort. But how about the shop delivering 7-10 of an engine per stall per month? It is not possible, unfortunately, to figure accurately the cost and lost time and labor resulting from an output ratio of this low figure.

Let us now consider the modern shop operated with the assistance of a complete scheduling system. Engines are thoroughly inspected before being brought into the shop, and all material needed is on the ground, not simply on requisition. The policy of the management for this shop is to allow the shop superintendent to bring in engines at his discretion, and the line-up is not dictated by some higher officer. Twenty-five engines, inspected and chosen for properly balancing the work of the shop organization, are then brought in on the 25 pits available and exactly in accordance with the space designed for placing engines when the shop was built. Dates are then set for these engines to go out completely repaired and every operation and all important material is scheduled to be finished at certain proper times in order to erect the engine in the most orderly and systematic manner. The output is figured at the low estimate of 50 classified repairs for the month, or two engines per stall or pit.

Now comes the most important feature of this properly operated shop. When an engine drags for some reason, the cause is sought out and immediately remedied and those responsible for the condition are penalized with red delay marks on the schedule office boards and the daily delay sheets advertise to all superiors and supervision the department which is deliquent and the cause. What is the result? Foremen are not pleased with this situation, and take steps at once to line up their material and forces to rectify it. No man with any ambition at all wants to be known as a slacker or as having "fallen down" on his job and caused others to be late and censured. Men are not shifted from this late engine as was done in the old-fashioned shop. This

would be the easiest way out and following the line of least resistance, but the most costly way in the end, as is always the case through life. Everyone is stimulated by the supervision, including the shop schedule supervisor, to appreciate their responsibility for meeting the promises made to superiors for the delivery of the engine on time. Consequently they all "go to it" with energy and a quiet determination to overcome the obstacles speedily. Responsibility is the greatest sobering influence, and a proper sense of responsibility is what we need in our shops today.

The primary beneficial result from these up-to-date methods is character development. The shop superintendent and foremen and all the way through the ranks, begin to realize and understand that when an engine is scheduled out, that settles it, and the engine must be worked on continuously and faithfully until it goes out, barring the most unforeseen reverses, even if a week late. Gradually the general status of the whole shop is raised, the morale of the supervision and men improved and a desire to win stamped on every mind. This spirit and desire for honest orderliness and conscientious work is the only known condition through which a shop may be developed to produce the output for which it was designed. It is admitted, of course, that adequate machines and organization are first installed. Shorter hours, abolition of piece work and social unrest have their influences, but fundamentally the above discussion is logical and conclusive.

SALVAGING HIGH SPEED STEEL SCRAP

BY SAMUEL S. BUCKLEY

The process used by the Onondaga Steel Company for reclaiming high speed steel scrap is based on a careful selection and grading of the material to be reclaimed. To be successful, the converter of high speed steel scrap must return to the customer a steel that is as good if not better than the original high speed steel, and it is not wise to endeavor to produce any other than the required standard. The converter must be guided in his action to a great extent by the type of steel submitted, the larger proportion of which will contain 18 per cent tungsten, about 4 per cent chromium, approximately 1.20 per cent vanadium and carbon between .60 and .70 per cent. Being held to the standard type, he has no opportunity of improving this steel by a change in composition.

The converter of high speed steel scrap has had to overcome the notion that because scrap is used as a base the steel produced must be of inferior quality. Satisfactory results have been attained, however, only by the use of extraordinary methods in the selection and proportioning of new material, and extreme care in handling it through all the steps of the process. The idea that only scrap is used in melting is erroneous. No matter how carefully tested and selected the scrap may be, new additions of muck bar, tungsten, chromium, vanadium, etc., must be made to "sweeten up" the melt, as a steel maker would say. If high speed steel scrap were melted without this sweetening, the resulting material would have lost some of its elements, particularly vanadium which is quite volatile, and it would be apt to show shortness or brittleness, possibly from the same reason that cast iron becomes more brittle each time it is melted over. The scrap received is separated into either first, second and third class, or is rejected.

The first class comprises high speed steel scrap containing 15 per cent tungsten or over. The second class consists of scrap with between 15 per cent and 12 per cent tungsten. The third class, which has some value, though hardly worth converting, consists largely of the old-fashioned self-hardening or mushet steel.

Rejected material consists principally of the straight carbon tool steel and odds and ends of ordinary soft steel and discard that would ordinarily be classed as junk. In these rejections are included drills, reamers and other tools with soft steel shanks, oil tube drills having copper or brass oil tubes, tools that have shanks or parts brazed or soldered upon them. Tools with soft steel shanks can be partially reclaimed by breaking off these soft steel parts well into the high speed steel. The reason for the rejection of the above mentioned soft steel parts is due, of course, to the fact that they are usually made of nickel steel, and nickel as well as copper or any other non-ferrous metals are absolutely tabooed in high speed steel, therefore the maker dare not chance the addition of even a small percentage of any of them.

The Spark Test

In order to develop an absolutely uniform material from the miscellaneous scrap sent in, it is necessary for every piece to be tested by some quick, economical and reliable method. It was found after much experimenting that a spark test was the most satisfactory.

For the testing of high speed steel scrap, assuming that it is free from the metals or soft steel parts referred to, it is necessary to have a soft free cutting alundum or corundum wheel running dry, at a speed given by the maker, and located in a dark place so that sparks may show to the best advantage. The spark test is based on the fact that each separate grade of high speed steel develops a characteristic spark by which it can be identified under these conditions. To conduct this test the operator should take samples of steels of known quality and thoroughly familiarize himself with the different sparks shown by them when in contact with the wheel. The color, shape and length of the spark stream should be carefully noted. These sparks will show a dull red stream 6 to 20 in. from the point of contact with the wheel, at which point there is an explosion or opening up of the spark stream. Some high speed steels show a bright star effect, while others break up into lines similar to but brighter than the line running down from the point of contact. Experts can pick out most of the various standard makes by the difference in sparks. This can only be done, however, by experts who have made this a deep study and who are continually in practice.

Take, for instance, the old-fashioned mushet type of self-hardening steel. This throws off a spark very similar to high speed steel with a stream that has a slight tendency to open up at the end but not into what might be termed an explosion. It is interesting to try the spark test on ordinary gray iron, as this resembles very nearly the spark of the old-fashioned mushet steel. It is not unusual, in fact, to receive gray iron on the assumption by the sender that it was tungsten steel.

The American self-hardening steel shows a brighter spark stream and a still brighter explosion than the mushet steel, and can be distinguished from high speed steel by the length of the spark stream and the difference in the color and size of the spark or explosion at the end of the stream.

The molybdenum self-hardening steel, a great deal of which was placed on the market just previous to the advent of high speed steel, shows a spark much brighter than high speed steel but of a character peculiar to itself — not having the brighter scintillating spark of carbon steel, but ending in a long stringy, comet-like explosion at the end of the spark stream.

There are several grades of self-hardening steels made for wood cutting, nail dies, etc. These all show a lighter spark, being low in chromium and tungsten. Then follows the double special or finishing steel, which shows a considerably brighter spark and a lighter red stream. There are some one and two per cent tungsten steels for tools on the market.

Any type of simple steel, such as tool steel or any ordinary soft steel of whatever character or shape, as well as nickel steel, can easily be recognized by a bright spark stream and brilliant scintillating spark explosion.

SQUARING THE FRAMES OF FRENCH LOCOMOTIVES

Special Gages Aid in Squaring the Locomotive Frames and Lining the Driving Box Shoes and Wedges

BY MAJOR C. E. LESTER
Formerly Gen. Supt., 19th Grand Division, A. E. F.

IN overhauling French locomotives at Nevers shop, France, it was customary to remove the boilers and cylinders from the frames and, after stripping off all braces, lugs, shoes, etc., to give the frames a thorough cleaning and careful inspection for defects. A view of a pair of cylinders and frames just unwheeled is shown in Fig. 1. Frequently the frames were sent to the smith shop for repairs, and in their reapplication or in the application of new ones, the squaring gage, Fig. 2, was used. The purpose of this gage was to assist in squaring the frames with the cylinders and with each other, and to check for frame distortions.

It may be explained that frames on the smaller French locomotives are of the slab type about 1½ in. thick and the driving box shoes are bolted to the frame jaws by a suitable number of taper bolts as indicated in Fig. 3. The driving box wedges are provided with tongues which fit into

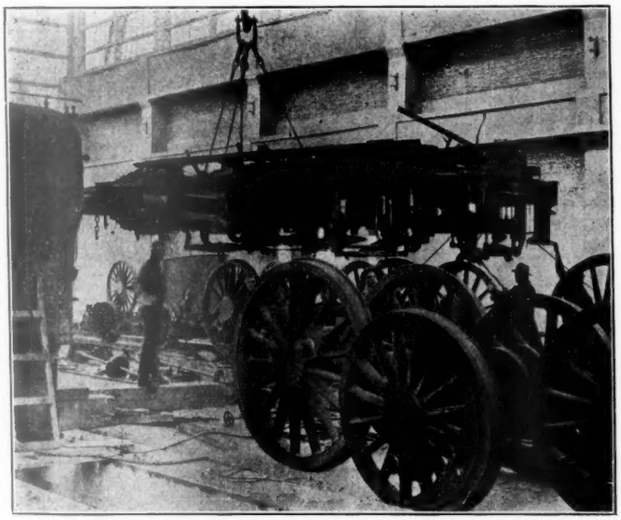


Fig. 1. French Locomotive Cylinders and Frames Just After Being Unwheeled

corresponding grooves in the female shoes, the latter also being bolted firmly to the frame jaws. The above arrangement of the shoe and wedge also is shown in Fig. 3.

When a locomotive was ready to be reassembled, the frames were bolted to the cylinders and the braces bolted up. The cylinders and frames were adjusted by means of jacks until level, as indicated by the spirit level. A string passed from the center of the cylinder to the rear of the frame was adjusted until exactly in the prolongation of the center line of the cylinder, and any offset in the frame could be detected by measuring the distance between the frame and the string. If there was a slight offset at the rear, due to a bend in the frame, the frame was left alone and bent back into position after putting the boiler in place. Reference to Fig. 4 shows blocks of wood placed midway in the jaws, which acted as a rest for the squaring gage (Fig. 2). The latter was placed so that the gage arm could swing on the outside, the gage beam extending through the frame from jaw to jaw. The sleeve shown was slipped on over the gage beam and held in place by a set screw. With the sleeve held against the frame jaw, the gage could not slide back in adjusting the set screw.

To square the frames the set screw was adjusted until, with the gage arm swinging, the end of the screw just touched the string. After being adjusted for the back jaw, the gage was moved to the main or front jaw without changing the screw. The gage arm was swung, and if the screw touched the string no adjustment of the frames at that point

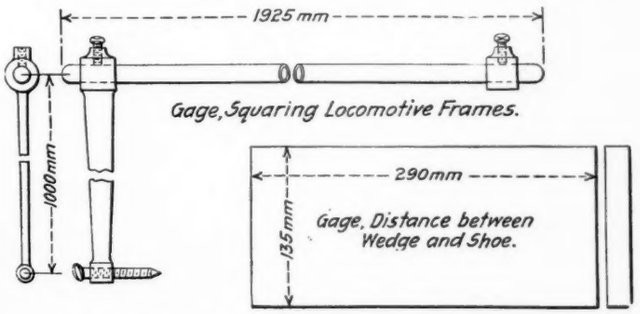


Fig. 2. Gages Used in Lining and Squaring Frames

was necessary. If, however, the screw did not touch the string it was necessary to move the frame one way or the other or to shift the cylinder by means of jacks. Occasionally, with new cylinders it was necessary to remove them and have a little planed off.

After using the gage on one side of the frame it was applied to the opposite side in the same manner as described above. The frames were adjusted until, without changing the screw adjustment, its point just touched the string when

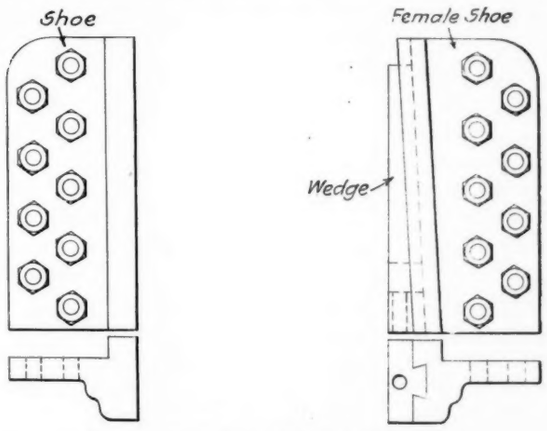


Fig. 3. Shoe and Wedge Arrangement

the gage was used on either side of the frames or at any pair of jaws. With this condition fulfilled, the frames were considered square. The spirit level was again tried, to be sure that the cylinders as well as the frames were level and had not shifted.

Driving Box Shoes

Before bolting on a driving box it was necessary to have the correct distance between the wedge and the shoe. This

distance was obtained by means of a rectangular gage, illustrated in Fig. 2. The gage shown was used for the 4,000 class locomotives and other gages of a similar type were provided for the other classes. When the wedge had been fitted to the female shoe, the rectangular gage was placed against the wedge and a distance of 40 mm. equal to the shoe width measured in excess of the 290 mm., representing the driving box width. This indicated the proper position in which to bolt the shoe.

When the shoes had been bolted to the frame, the straight

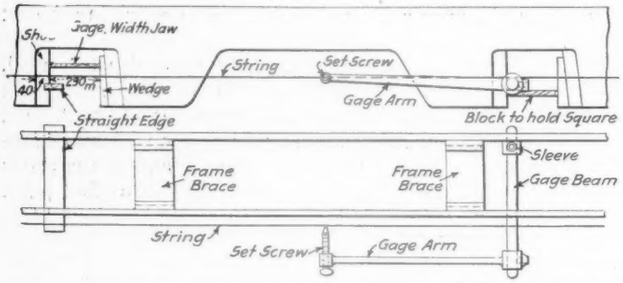


Fig. 4. Plan and Elevation of French Locomotive Frames Showing Application of Squaring Gage

edge, as shown at the left in Fig. 4, was placed so that it fitted over the shoes and checked the distance between frames. Three trams were used to obtain the correct distance between the jaws; back to intermediate; intermediate to main and main to front. With the frames carefully squared by the above method and the shoes and wedges lined there was no difficulty in wheeling the locomotives and applying the rods.

CARE AND USE OF PNEUMATIC TOOLS

BY H. S. COVEY

There are four indispensable things required in the successful operation of the air tool, and these are dry air, volume, uniform pressure and lubrication. Dry air may be had by piping the receiving tank in the following manner: The tank should be large, set in a vertical position and provided with a draincock at the outside near the bottom. The large shop pipe should enter the tank from the outside at a point 12 in. from the bottom. When the air reaches the tank from the compressor it is exceedingly hot and has a pressure of seven to eight atmospheres; being hot, it immediately rises to the top of the tank, as does each succeeding pulsation. The air being tapped in the tank, it must remain there until sufficiently cooled. As condensation starts at once, the water falls to the bottom of the tank. As the air cools and drains, it moves downward until it finally reaches the mouth of the shop pipe and moves on its journey to the air tool in good working condition.

Volume and Pressure.—To maintain adequate volume and uniform pressure, the shop mains should be large, as they are the trunk lines which carry the air to the most distant point of the system; they should have a gradual rise until when they reach the most distant point they are considerably higher than the receiving tank. All branch lines which cross the path of the main trunk line, from which they draw their supply, should always pass above and take their air from the top of the main pipe. If there is any water still in the mains, it is at the bottom working its way back to the supply tank.

Compressed air is saturated with oil from the compressor and is never quite eliminated at the receiving tank where the first cooling of the air takes place, as previously mentioned. A considerable proportion of the oil, therefore, passes on through the shop mains and branches to the drop pipes, at which point the hose line is attached, leading directly to the air tool.

The oil has a detrimental effect on the rubber innner tube of the hose, causing it to disintegrate, particles of which become detached and enter the air tool, where they lodge in the valves and air ports of the hammer, causing serious trouble and inefficiency.

Oil and Water Separator.—Inventive minds working on this problem have recently discovered a simple device which we believe to be a solution of the trouble. This is an oil and water separator that may be made in your own shop at a nominal cost. It consists of a 3-ft. section of 5-in. iron pipe, capped at top and bottom, and is attached to the branch air pipe lines which feed the drop pipes and hose lines. The branch pipe enters the separator at the top through one side of the cap and runs down the inner side of the separator to a point three inches from the bottom when the air is liberated, escaping into the cylinder and returning to the top of the cylinder through a series of baffle plates which are attached at regular intervals to the branch pipe; this filters the air and the oil clings to the baffle plates.

The air leaves the separator at the top, entering the branch outlet pipe attached to the cap at the opposite side to the inlet. The air is thus freed from oil and such water as may still remain in the system.

The separator is drained of its accumulated water and oil through the drain cock provided at the bottom cap of the separator. Occasionally the lower cap of the separator should be removed and the baffle plates cleaned by means of a stream of compressed air which quickly removes the oil adhering to them.

Fittings.—The selection of proper fittings that will offer the least resistance to the passage of the air is just as important as large pipe lines to aid in the reduction of friction in transmission of the air from the drop lines through the hose to the air tool. Air valves which have any angle turns in the air passage are objectionable, because they impede the direct travel of the air into the hose. Hose couplings, like the valve, should have an unobstructed air passage.

Lubrication.—The close fit of all working parts of the air tool necessitates frequent lubrication, particularly in the riveting and chipping hammers. The oil used should be of good quality that will not gum; heavy black machine oil should never be used, as there are numerous air ports in valve blocks and cylinders that must be kept open. The tendency of the heavy oil is to clog these ports, which impedes the proper circulation of the air and reduces the power of the tool.

If the air is charged with water it washes away all lubricant and the hammer loses its efficiency, refuses to work, and the delicate parts and polished surfaces become rusted. The hammer should have a bath every night in coal oil, which soaks up the worn-out oil of the day, and each morning should be attached to the hose and blown out thoroughly, then fresh oiled and put in service. If treated in this fashion it will perform like a new tool.

*From an address by H. S. Covey before The Railway Club of Pittsburgh. The author is secretary of the Cleveland Pneumatic Tool Co.

MORE EQUIPMENT NEEDED.—Industry continues to be hampered by inefficient transportation. This is not a condition which can be materially aided by redistribution of cars, but can be remedied only by the purchase of a large amount of new equipment and the heavy repairing of old. Although a number of railroads are now in the market for rails, cars and locomotives, the buying movement has not yet reached large proportions. Extensive purchases on the part of the roads must wait the making of adequate financial plans. Some needs, however, such as the requirements of the repair shops, are so urgent that buying of this kind cannot long be postponed.—*National Bank of Commerce in New York.*

How Enloe Straightened Out Westdale*

The S. M. P. Thought Berry Was "Falling Down." A Visit to the Terminal Showed Why Engines Were Delayed

BY FRANK EDWARDS

THINGS were not going well at the Westdale roundhouse and hadn't been for more than a year. Westdale was the most important terminal on the Valley Division of the Central and was hard to handle even under ordinary conditions. With the unusually heavy business, which had kept up the entire year following the war, had come a dearth of competent mechanics. The combination had changed the division's standing from one of the best on the system to one of the worst. If a day went by without an

Enloe Delighted in Recounting Some of the Rush Jobs He Did

engine failure, two would occur next day and Roundhouse Foreman Berry was in despair.

Charley Berry had been made on the division and until recently had been considered a coming mechanical department official. He was just in his prime, was well liked by all the men, and was a thorough mechanic, yet the engine failures and delays were increasing monthly. Master Mechanic Gridley and Mechanical Superintendent Enloe were beginning to doubt the wisdom of leaving him longer in charge of the Westdale roundhouse. Berry had tried many times to make them see that he was handling the work to the best advantage and that all his trouble was due to the large increase in business with an actual decrease in the force, and this force only turning out about half the work it did before the war.

Enloe had made his reputation as foreman at Westdale and ever delighted in recounting to Gridley and Berry some of the rush jobs he did when he was running Westdale. Gridley had first made good on about the same kind of a job on another division and both were inclined to feel that what they could do in the good old days Berry could do now if he would just organize his force right, although neither of them could pick any definite flaws in Berry's methods.

As Enloe was leaving his office on day to go to lunch he met the general manager, who promptly said, "Enloe, I just came in on number eight. We had a 30 minute delay at Westdale on account of the engine being late and then lost 40 minutes from there in with the regular train. They tried three engines before they got one ready and it wouldn't steam. What is wrong over there, anyway?"

Enloe replied, "Things haven't been going right over there for some time. I have about decided that Berry isn't heavy enough for the job."

"How is he fixed for men?" asked the general manager.

"Why, he has more men than I ever had," replied Enloe. "Business is some heavier but I consider that he is well fixed for men. He doesn't seem to be able to handle them right. I'll investigate this delay to number eight and let you know what I find. I've about made up my mind to go over there and stay till I get that place straightened out if it takes a month."

"That might be a good idea," said the general manager, "for we are having nearly every meat train delayed there for power and then when they do furnish an engine it is usually late and frequently loses time over the division."

Other matters were then discussed but for the remainder of the day Enloe was not able to get his mind off conditions at Westdale and the delay to number eight. He knew that Gridley did not have time to make a long stay over there yet he was convinced that either himself or Gridley would

"Hansen, What Took You So Long On That Rod Brass"

have to go and stay for a while in order to get Berry lined up.

Next morning when Enloe reached his office he found Gridley waiting for him.

"I have just received a wire from Berry," said Gridley, "he fell off of number ten's engine last night and broke his right arm. The doctor is sending him to the hospital this morning and claims he will be gone three or four weeks at least. I'll go over on number nine this morning and get someone broken in on the job."

"Who have you got over there to handle the work when Berry is off?" asked Enloe.

"Well, we haven't anyone just now," replied Gridley.

*Entered in the *Railway Mechanical Engineer's* Prize Story Contest.

"You know Berry wanted our permission to break someone in on his job last time we were over there but we decided it wasn't necessary and we didn't want him to take a man out of the gang just then. Lane and Smith both used to be able to handle that place in emergency but they went to the navy yard and never returned. This is going to delay all the work we had planned on this end for a week or two unless you can arrange to oversee it yourself. I'll probably be over there a week or more."

"Now, say," interrupted Enloe, "I just promised the general manager the other day that you would start that work on this end today and that you would personally see it through. I've got things in the office in pretty good shape and I'll go over to Westdale myself and run that place until Berry gets back or at least stay till I get someone lined up that can handle it. I handled it once and I have been wanting a chance to straighten it out again. I know most of the boys down there. A few of them were working when I was running the place and I'll pick out one of them and stay with him until he gets started."

As soon as number nine reached Westdale Enloe hurried to the roundhouse and to his surprise found a young man named Scott in charge. On questioning Scott he learned that Berry, against instructions, had had the foresight to break a man in to protect his place. He soon decided that Scott appeared to be entirely competent.

The first day passed without any bad luck and Enloe spent most of his time looking over the engines in the house and in conversation with some of the oldtimers or consulting with Scott.

When Enloe reached the roundhouse next morning Scott hurried to explain that the 503 had just come in off the Baileyville branch with a front end brass that had to be reduced. "It is nine o'clock now and we just got her in the house," said Scott. "She is due to go back at ten and the chief just told me he wouldn't stand for any setback this morning as they had some stock to pick up going back. We haven't got another engine here we can use."

"We can make that all right, Scott," returned Enloe. "Let Hansen have the job. He has reduced a brass like that for me in 45 minutes many a time. I saw him working on the 816 down there. I'll see him at once and explain what we want."

Enloe found Hansen and said to him, "Hansen, the 503 is just in with a front end brass cut out. I wish you would start on it right away and do your best on it. We want to run her at ten o'clock. You have done the same kind of a job for me many a time in 45 minutes."

"I'll do all I can, Mr. Enloe," replied Hansen.

Enloe felt so sure that Hansen would finish the job on time that he dismissed it from his mind and went over to the car department and watched the work for a while. He returned about 11 o'clock and Scott explained that he had had a 30 minute delay on the 503 due to Hansen not finishing the rod brass in time. When he finished Enloe exclaimed, "Hansen has got to explain to me what took so long on that job. There is no excuse for it."

Enloe at once found Hansen and began, "Hansen, what took you so long on that brass? I've seen the day when you could have done that job in 30 minutes."

"Mr. Enloe," replied Hansen, "I am just as fast as I ever was but we don't work like we used to work. When you were here, I would have taken that brass down, reduced it with a hammer and chisel and file, hurried over to the shop and cut a liner myself and as you say I would have been done in about 30 minutes. Nowadays I can't reduce a brass myself for you have agreed with the shop committee that it is a machine job so I had to take it to the machine shop and wait for it to be done on the lathe. He had a rush job in the chuck and that delayed me 25 minutes. Then I had to hunt up a boiler-maker to get a liner cut as your agreement with the boilermakers won't permit me to cut a liner. It took me ten minutes to find him and get the liner cut. I hope that makes it plain to you why I did not finish the job as soon as you expected."

"It does," said Enloe as he walked away.

This incident gave Enloe enough to think about for the rest of the day, and he began partially to understand why Berry was not able to turn out the work as he used to. In the afternoon when Scott found a moment's leisure he said to Enloe, "Mr. Enloe the 822 will be in on number seven tomorrow morning and we have got to change her tires. She lays here 20 hours and I'll try to change them during her layover as we haven't got an extra engine just now. She is due to go back on number eight at five o'clock next morning but if we don't finish her we can double number eleven's engine back."

"There is no reason why you can't get the tires changed and get her out in her turn," replied Enloe. "I have seen

He Found Carlson and His Helper Sitting On Their Tool Boxes

Carlson change tires on that class engine more than once and have her ready to go in 12 hours. Better put him on the job and let him stay till he finishes it."

"I'll arrange to do that," said Scott.

Enloe was on hand early next morning determined to see that there was no delay in starting on the tires. He made it plain to the hostlers that he wanted the 822 hurried in the house but it was after ten o'clock before they could get the big Pacific type engine across the pit and in the house. Enloe and Scott both explained to Carlson that they expected him to change the tires on her and get her ready for number eight in the morning.

Carlson merely said, "I'll do all I can."

When Enloe started for lunch just before noon Carlson had all the rods off and was ready to jack her up. When he returned about one o'clock he found Carlson and his helper sitting on their tool box watching four laborers jacking up the engine. These men were working half-heartedly and it took but a glance to see that they were inexperienced, thoughtless and making about one fourth the progress that two good energetic men could make. On seeing Enloe Carlson got up and remarked:

"We are all ready to go, Mr. Enloe, as soon as the boys get her jacked up. I've got everything ready."

"Those fellows aren't making any headway," replied Enloe. "Why aren't you and your helper working with them? I've seen you and one helper jack up an engine like that in half the time they are doing it."

"We can't do it, Mr. Enloe," returned Carlson. "You see our shop agreement says that the mechanics and helpers will be relieved of all heavy jacking when there is a labor gang working. Scott can't spare any more of them just now."

Enloe saw green for a moment, then turned and walked away thinking of the many times he had seen Carlson in action on just such a job and how impatient the same man used to become when someone did not appear to be working fast enough and how he seemed to brush every obstacle aside in his efforts to get a job done on time.

At four o'clock, which was the quitting time for the day shift, Carlson had one tire off and was heating another. Enloe had expected him to have all six tires off by four.

Scott was well aware that Enloe was not satisfied with the time Carlson was making on the tires and for that reason hesitated about explaining that owing to the agreement he could not hold Carlson overtime on the job. Finally just at four o'clock he found Enloe and explained the situation to him.

"Mr. Enloe, we can't work Carlson overtime on that job as he has already had more than his share this week and the committee has notified me that it is James' time to work. I tried to explain to them that Carlson was the best man on tires and that we just had to have the engine for number eight but they took the position that it wasn't the machinist's fault and the company didn't have another engine here to protect their train and that the agreement was made to live up to."

"What kind of a man is James?" inquired Enloe. "I don't know him."

"He is all right," replied Scott, "on some kinds of work and can set tires but he won't make half the time that Carlson would make but we will have to use him or let the job wait.

"Go ahead and use him," said Enloe. "I can see now that you won't get her finished in time for number eight but you can double number eleven's engine back as you suggested. I believe I'll go on down to the hotel. You seem to be doing all I could expect of you, on this job, and I'll go in on number eight in the morning."

Enloe sat late in his room that night. He was thinking of the many new problems that confronted the present day roundhouse foreman and at last he could understand why hardworking Berry—hardworking with head as well as muscle—was unable to get the work done that he himself used to get done with the same size gang. He thought of the many times Berry had tried to explain all this to him and how he had refused to believe. He also came to understand why the engines' failures on his district were more numerous than on any other district of the system and that his success in holding his payroll down had cost him the high standing of his district. It was plain to him at last that labor conditions had changed greatly since he was a roundhouse foreman.

Next morning the engine for number eight was 35 minutes late. James didn't get the tires finished in time and number eleven's engine reached Westdale with a broken spring hanger. The night foreman had no other engine so had to make repairs and this caused the delay. As usual, Scott sent a statement to Enloe and Gridley explaining the delay and in this case Enloe did not close it out by saying the delay was evidently due to the poor judgment of the foreman.

It will probably never be known just what explanation Enloe made to the general manager but before Berry returned from the hospital the force at Westdale and also at the other roundhouses on Enloe's district had been increased 25 per cent. Three months later the Valley Division had again become the best division on the road, all due to Enloe lining up Westdale.

INFLAMMABLE AND EXPLOSIVE LIQUIDS IN SHOPS*

Railroad shops, especially large ones, are usually closely grouped for economy in operation, and often the congestion is such, that it renders a large proportion of the property subject to loss from one fire. Many shop properties have been added to from time to time, without much thought as to segregation of hazardous processes. This risk is increased by the fact that locomotives move in and about the shops, thus making a spark hazard. Extreme care should be applied to safeguarding the hazards, especially in the use of inflammable or explosive materials; otherwise quick spread of fire and heavy losses are not improbable.

The inflammable liquids used in railroad shops are gasoline, benzine, paint and varnish, oils, wood alcohol, paint and varnish remover and lacquers.

Gasoline

Where the main stock of gasoline or benzine exceeds 50 gal., it should be stored in underground metal tanks installed in accordance with approved regulations. Where the main supply does not exceed 50 gal., a steel drum of 50-gal. capacity with a metal faucet is a satisfactory storage container. This drum can be kept in a small, well detached metal enclosure that is kept locked and is conspicuously marked "Keep Lights and Fires Away." Where not over five gallons constitute the main supply, an approved safety can may be used. This can should be kept in a cool place. For transferring gasoline from the storage tank or drum to the point at which it is to be used, only approved safety cans should be used. These safety cans preferably should not exceed one gallon in capacity, and should be smaller if a smaller amount than one gallon is sufficient for a day's supply at any point.

In cleaning triple valves, some shops use gasoline while others use kerosene with apparently satisfactory results. Where gasoline is used it should preferably be placed in substantially constructed galvanized iron cans of as small size as practicable for the purpose. These cans should be mounted on the work tables, so that their tops are almost flush with the surface of the table, and should have a drain valve at the lowest point of the bottom. Cans should be provided with hinged covers which normally will be shut to prevent evaporation of the gasoline. Gasoline remaining in these cans should be removed through the draining valve at the close of each day. This cleaning work should be conducted at a point remote from open fires, lights or flame, and only approved electric light fixtures should be permitted.

In cleaning electric generator and motor parts with gasoline, similar precautions should be taken as in cleaning triple valves, except that more gasoline and larger cans must be used in the latter process owing to the size of the parts handled. The form of can should be of such proportions as not to be upset easily, as they are usually handled on the floor. They should be provided with hinged covers and with substantial handles, and the liquid contents should be removed from the cans and stored outside the building at the close of each working day.

Gasoline is sometimes required for removing grease and oil from upholstery and furniture. The gasoline for this purpose should not be kept in or around the shops in glass bottles or in open cans or buckets; but in a small standard safety can. When using gasoline for dry cleaning, it is recommended that the material to be cleaned be taken out doors when practicable. In cleaning cloth surfaces with gasoline, the mere friction of the cloth saturated with gasoline upon another surface is sometimes sufficient to produce

*From the report of a committee presented at the sixth annual meeting of the Railway Fire Prevention Association, held at Chicago, November 18-20, 1919.

static electric sparks, which may ignite the vapor. Fires sometimes thus occur in dry cleaning processes, in spite of every precaution in avoiding the proximity of open lights or fires.

Gasoline is used in small blow torches or plumbers torches for soldering in electrical repair shops and also for burning off paint. In some shops kerosene is used for the same purpose and naturally involves a much less fire hazard. Where gasoline torches are used they should be kept in a fire proof cabinet, preferably located outside, when not in use. They should be filled from a standard safety can, and this filling preferably should be done out of doors. The torches should be inspected frequently to insure that they are in good mechanical condition. Fires are frequently caused by workmen going away and leaving burning gasoline torches. The torch may be upset or moved so that the flame comes in contact with some combustible material.

It is of course important in using gasoline or kerosene torches for burning off paint, that they are not used at any place where varnish removing compounds are employed. In some shops large gasoline pressure tanks are used inside main buildings, and the gas produced is used in connection with blow torches for paint removing. Such practice is very hazardous and should not be permitted. These tanks should be in an underground pit, well detached from buildings, and an approved system of piping and connections should be provided.

Where tire removing is done with the use of gasoline fuel, the process should be conducted out of doors, and at a safe distance from buildings. Fuel oil and kerosene are both successfully used for this purpose at some points, and are safer than gasolines.

Paints and Varnishes

Paints and varnishes used in railroad shops are not generally highly inflammable, but are combustible, and are usually kept in quantity. They should be stored if practicable in a separate building of fire resistive construction, located a sufficient distance from other shop buildings to eliminate the danger of exposure. Paints and varnishes should be stored in sheet iron drums provided with valves for drawing off the liquid. Metal pans or troughs should be placed under the valves to catch any drips. Standard metal waste cans with self closing lids, should be provided for the reception of waste, or cloth contaminated with paint, oil or varnish. This material should be removed from the cans at the close of each day, and burned or otherwise safely disposed of.

In case any paint, oil or varnish is spilled, it should not be absorbed by sawdust, or similar material; sand should be used for this purpose.

The paint storehouse preferably should be of brick, or concrete construction. It is recommended that wire glass set in metal frames be used for window openings, and approved metal covered fire doors for door openings. At the openings between various sections, small two-inch concrete sills should be provided. The building should be heated by steam and lighted by electricity, wired in conduit, with vapor proof globes, and switches installed outside of the building.

Where practicable the oil storage should be a separate building from the paint and varnish storage. When housed in the same building a distinct sub-division should be provided between the two occupancies by a standard brick fire wall, with door openings protected by a standard fire door on each side of the opening. Oil houses should be divided into two distinct rooms; the waste room, and the main oil dispensing room. Sometimes a third room is necessary for filled barrels, where no basement is provided. The construction, lighting and heating of the oil house should be similar to that recommended for the paint and varnish storage.

The most common form of fire protection for paint, varnish and oil houses, is the steam fire extinguishing line, by which steam is introduced into the building. These lines are controlled by manually operated valves located on the outside of the building. The effectiveness of this method of fire extinguishment is dependent on the complete confinement of the steam. In order to prevent its escape, all window openings should be equipped with wired glass in metal frames, the windows to be counterbalanced to close with the melting of fusible links. If there are ventilators in the roof they should also be equipped with shutters with fusible links. Chemical fire extinguishers, and a liberal supply of sand pails should be provided. On the outside of the building a sign should be posted reading, "Keep Lights and Fires Away."

Empty and filled oil barrels or drums should be stored at as safe a distance as practicable from the oil house, and as an added precaution, protected from sparks by a noncombustible shelter. All empty barrels or drums should be tightly closed.

Paint and Varnish Remover

Paint and varnish removing compound is usually a highly inflammable liquid containing acetone, benzol, etc. It is commonly shipped to the shops in wooden barrels, which are stored outdoors until used. These barrels are not always in good condition when received, hence they should be inspected when received to see that leakage and fire risks do not occur. When paint and varnish remover are being applied to cars, these cars should be outside of and at a reasonable distance from any building. During this process no fires, lights, blow torches, etc., should be brought in the vicinity of the car.

In removing paint and varnish from small pieces, it is at times necessary to work indoors. A small detached building should be used for this purpose. This building, if not of fire resistive construction, should have all combustible parts covered with sheet iron. When dipping tanks are used for the varnish remover, these tanks should be kept covered except when objects are being placed in or removed from the tank. Not more than one barrel of the varnish remover should be kept in the building or compartment in which varnish removing work is done. Care must be taken that any liquid which has spilled or leaked is at once removed. The building should be well ventilated, and if lighted artificially, vapor proof electric lights with wiring in metal or other conduits must be used.

Metal Lacquers and Enamels

Lacquers and enamels for metals consist essentially of nitro-cellulose in amyl acetate solution, with or without other ingredients. Lacquers and enamels are commonly shipped by the manufacturers to the consumer in boxed cans of not over five gallons capacity. They are commonly kept in these shipping containers until used. Lacquers and enamels are usually applied either by dipping or spraying. When applied by dipping, the dip tanks should have approved covers, and these covers should be kept closed except when articles are being dipped or removed.

Where lacquers or enamels are applied by spraying, the work should be done where there is good ventilation. Ventilators, work tables, or other objects which are in the path of the spray, gradually acquire a coating of non-volatile residues from the lacquers. This residue consists, in large part, of dry nitro-cellulose mixed with gums, pigments, etc. This mixture is extremely inflammable, and if ignited in any quantity will make a very hot fire and one difficult to extinguish. These solid residues should not be allowed to accumulate, but should be scraped up, removed, and burned at frequent intervals. Drip boards should be of non-combustible material.

THE HUMP METHOD FOR HEAT TREATING TOOLS

The Critical Point of the Steel Being Treated Is Used to Determine the Proper Time for Quenching

ONE of the latest developments in heat treatment is the so-called hump method which has been developed by the Leeds & Northrup Company, Philadelphia, Pa. The method makes use of a recording pyrometer to determine when the steel being heated reaches the critical temperature, and takes its name from the fact that an offset or hump occurs in the heating curve at the transformation point. Heat treating by the hump method has been applied successfully to the

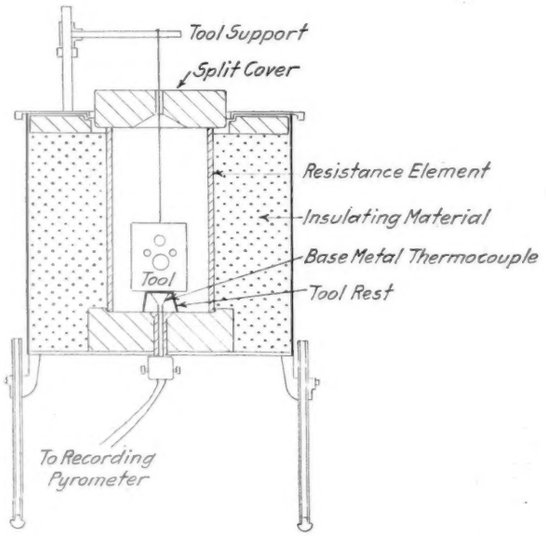


Fig. 1. Furnace Arranged for Heat Treating by the Hump Method

treatment of gears, taps, drills, punches, dies and other types of tools.

The usual practice when using this method is to heat the parts in an electric furnace of the type shown in Fig. 1. The tool is suspended by means of a small wire from the tool support in such a manner that it rests upon or is in close prox-

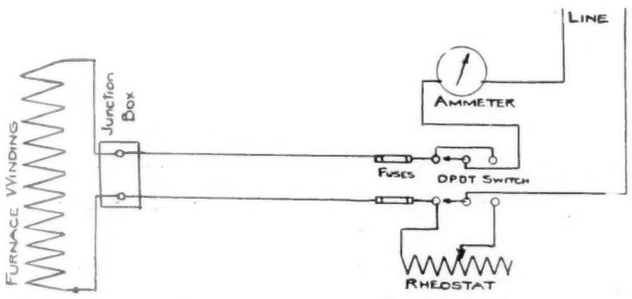


Fig. 2. Electric Circuit Connections for Controlling Rate of Heating

imity to the base metal thermocouple. The top and bottom of the furnace are made sufficiently tight to prevent any amount of fresh air to enter, so that the atmosphere is practically neutral at all times. In applying the methods to production work, the parts to be treated are placed upon suitable holders, and these are placed into the furnace, so that the work surrounds the thermocouple.

A rheostat is connected in series with the furnace winding, as in Fig. 2, by means of which the rate of heating of the furnace may be changed at will.

The thermocouple is connected to a curve drawing potentiometer recorder which gives a graphic record of the temperature of the hot junction of the thermocouple, but not the temperature of the work, at all times. The potentiometer recorder provides the maximum sensitiveness, and therefore enables the operator to note quickly a sudden change in the temperature of the hot junction of the thermocouple. A sample curve, showing the record of the temperature at all times while hardening a blanking die, is shown in Fig. 3.

Before the work is placed in the furnace the temperature of the latter is brought up to about 1,400 deg. F., as indicated by the thermocouple and as shown at point A on the temperature curve. The tool is then suspended in the furnace, the cover replaced and the control switch opened. Thus the energy input to the furnace ceases and the tool is allowed to slowly reach the temperature of the furnace or nearly so. In the meantime the temperature of the furnace walls will drop, as shown by the upper dotted curve. The thermocouple temperature drops rather suddenly when the cold tool is placed upon it, but soon regains some of its heat as the tool begins to rise in temperature. The rise in the temperature of the tool is shown by the lower dotted curve. When a sufficient length of time has elapsed all these bodies have reached

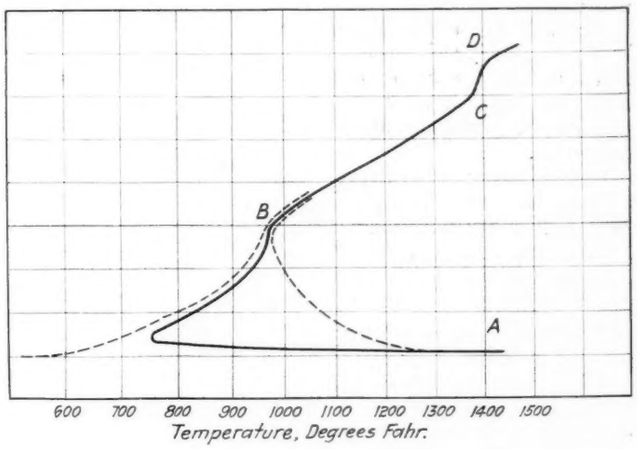


Fig. 3. Curve Showing Temperature Changes in the Furnace and in the Tool

approximately the same temperature, as shown at point B on the curve.

This means that all sections of the tool are at the same temperature, or in other words, the tool has reached a uniform temperature throughout.

At this time the energy is applied to the furnace and the current adjusted by means of the rheostat to a value just great enough to increase the temperature difference within the body of the tool at any time, and when the steel reaches its decalescence point all sections of the tool will be at approximately the same temperature. When the decalescence point or critical point is reached the carbide passes into solution in the iron (see *Railway Mechanical Engineer,* April, 1920, page 236). This change causes an absorption of heat without a change in the temperature of the steel.

Consequently the increase in temperature of the thermo-

couple is affected, as shown by the abrupt change in the slope of the curve at *C*. In fact, the thermocouple behaves just as if it had gone through a critical point. When the transformation is completed, there is another change in the rate of heating of the thermocouple, as indicated at *D*. The temperature of the tool is then allowed to increase for a sufficient time beyond this point to insure hardness and quenched, as shown at the point *E*. The time allowed above the "hump" depends upon the nature of the quenching medium as well as the mass and shape of the tool as is the case in any method of hardening.

The "hump" on the curve is used as a reference point, and by its use a number of the variables which occur in present methods of heating are controlled.

In order to properly heat treat a punch or die it is necessary to control the following variable conditions:

1. The amount of increase in temperature of the tool above its decalescence or critical point before quenching. A variation in this quenching point will result in a tool being soft when it is removed from the quenching medium, or will result in abnormal growth of grain size, causing the tool to be weak and very poor as regards physical properties.

2. The uniform rate of heating of the tool, too fast heating resulting in breakage, deformation or in setting up stresses which will cause an early failure in service. Too slow heating has been found to cause a volume change in the steel which results in a very appreciable increase in the cost of finishing the tool.

3. The atmosphere in which the tool is heated. An oxidizing atmosphere results in a decarbonized surface which decreases the efficiency of the tool enormously.

4. The quenching conditions. These, from present knowledge, seem to be more under control than the heating conditions.

The use of the electric furnace and the hump method of heat treatment provide a means of controlling these variables and enable the operator to repeat or change the heating conditions at will. It does not depend upon the accuracy of the pyrometer but upon its ability to show the time of the transformation.

The gas furnace and present "soaking" method of heat treatment do not allow a control of the quenching temperature because they depend upon the accuracy of the pyrometer, upon the operator's eye to judge the difference in temperature of the thermocouple and work, and also upon the assumption that the critical point of the steel in the furnace is the same temperature as the critical point of the sample, from which determinations were made in the beginning.

The use of the lead pot or salt bath eliminates to a certain extent the error caused by the difference between the temperatures of the work and furnace, but has the disadvantage over the gas furnace of too rapid heating with practically no control of the rate of heating.

The atmosphere is hard to control in the gas or oil furnace, and while decarbonization is not serious by the use of the lead pot, we are presented with the additional problem of keeping the tool free from lead spots by its use.

By the use of the hump method of heat treatment the steel is quenched at the proper temperature as measured from the critical point of the tool itself, and not of a sample of the steel. This makes it possible to control the grain size and physical properties and to repeat the results at any time.

The uniformity of heating and control of the rate of heating eliminates the breakage, distortion and volume change which are present where there is no control over these conditions.

Comparative tests were conducted on taps hardened in the electric furnace by the hump method. Because of the fact that there was very little volume change, and therefore very little lapping necessary on the taps, the hard outer surface of the tool was left intact, and in every case the electric furnace treated tools have shown a gain of from 25 to 50 per cent. In every case except one the gain was obtained before the first regrinding, showing the maximum work obtained from those taps was before the outer hard surface was removed.

There is no inherent reason why this method cannot be applied with gas furnaces, but up to the present time it has not been found possible to control the gas to secure a uniform rate of heating. A change in the quality of the gas or the pressure will cause a hump on the curve, which will not be the critical point of the steel.

It is necessary to have all tools in one heat of the same steel or of steels having the same critical temperature. The weight of steel in the charge must also be sufficient to insure a decided hump. A relatively small charge is sufficient, however. The curve shown in Fig. 3 was taken from a furnace 8½ in. in diameter by 14 in. deep when heating a carbon steel die weighing about two pounds.

The use of the hump method of heat treatment by no means eliminates all of the problems in hardening, but it makes it possible for the hardener to reproduce or change his hardening conditions at will and enables him to gain much valuable experience and knowledge that is now lost simply because conditions cannot be controlled or repeated.

The Careless Machinist's Creed and His Reasons

1st. I believe in using a monkey wrench in preference to a hammer, because a monkey wrench looks better when it is all battered up, and besides that is what it was made for.

2nd. I believe in borrowing other men's tools in preference to buying some of my own. This is a good method of cutting down the high cost of living and saves me carting around a heavy tool chest in my travels.

3rd. I believe in oiling my machine once every six months at least. This is a great saving to the company, as oil costs something these days.

4th. I believe in keeping the shop tools in a heap on the floor instead of using the locker provided for this purpose. In this way they can have their cutting edges ruined far more quickly than by using them on the work.

5th. I believe wiping off chips with my fingers in preference to using a stock or brush provided by the company, because the former is a most ancient custom and takes the place of a surgical operation.

6th. I believe in keeping tools under the planing machine table and in reaching for them while the table is running. This breaks the monotony of life and gives opportunity for some clever gymnastics.

7th. I believe, when running my shaping machine, in having my slide rest projecting far enough to hit the bed on the back stroke. This is great fun and provides employment for the repair gang who might otherwise be out of a job.

8th. I believe in wearing loose or torn overalls and a long flowing necktie when running a high speed lathe or drilling machine. This is also a very ancient custom and a suitable dress for machine-shop work.

9th. I believe in mixing brass, babbitt, steel, and iron chips in the pans. This mixture always looks well and proves fascinating employment to the man who has to separate them.

10th. I believe in using a long-handled wrench in tightening a three-quarter bolt and much prefer a half-nut to a nut on the whole depth. This ruins the bolt at once instead of prolonging its life indefinitely.

11th. I believe in blaming the night man when anything is lost or goes wrong with my machine. He is not here to contradict me, so I can explain it all to the boss satisfactorily.

12th. Finally, I believe in abiding by all the rules and regulations of the company to the best of my ability when the boss is around.—*By N. O. Good in Deane News.*

A Measurement Record for Railroad Shops

Tabulation of Dimensions of Parts Eliminates Errors and Delays in Making Repairs to Locomotives

BY H. L. BURRHUS

THE taking and recording of accurate measurements is essential in shop work in order to eliminate delays and errors in supplying repair parts for locomotives. In a roundhouse located at a considerable distance from the general repair shop there frequently is a long delay in getting parts because the proper dimensions are not known until the part is actually needed, and often in transmitting such information to the general shops errors are made which entail loss of time and confusion at both points. Much of this trouble can be avoided by utilizing information that is available in every shop.

A system of charts on which measurements of parts may be recorded will facilitate the handling of such work, particularly at outlying points having meagre shop facilities. This system may be called a "calibration system," although not strictly within the ordinary meaning of the term. Such a system is described in this article and typical charts are shown in the drawings.

When general repairs have been completed in the back shop it has been customary to destroy the record of measurements which were secured to make repairs to the various parts. For instance, driving box lateral was figured out on a slip of paper and handed to the driving box foreman. After the engine was wheeled, lateral checked and found to be correct there was no further use for that particular record, and it was thrown away so that it would not be mistaken for that of some other locomotive.

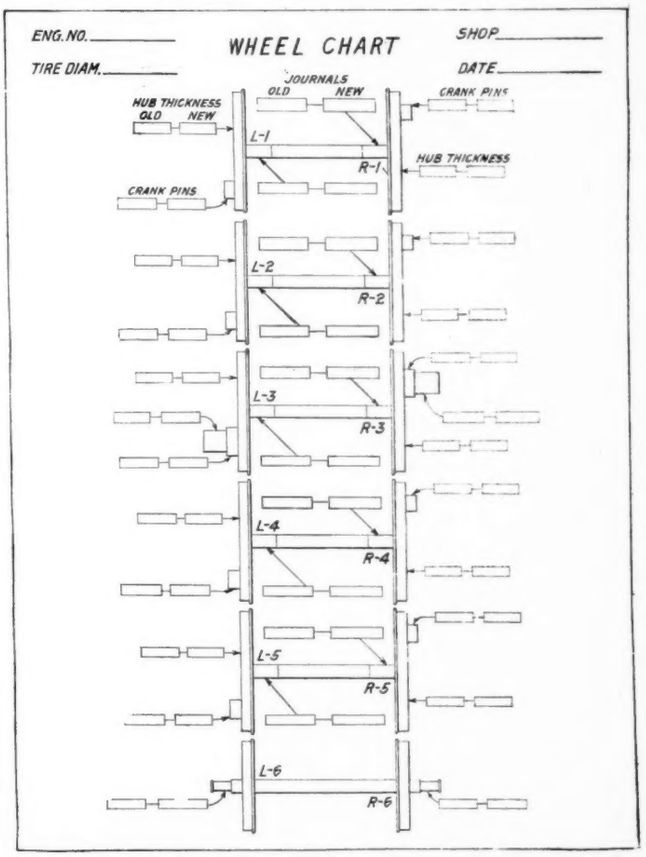
The mechanic who bores driving boxes will caliper the journals, list the sizes on a slip of paper and bore the set of boxes. As soon as the boxes are applied and found to be correct, this mechanic will destroy his record of sizes to avoid any confusion.

Cylinders are calipered for piston heads, and after the heads are applied, the measurements are soon forgotten. The shoe and wedge mechanic will caliper a set of driving boxes to secure sizes for laying out a set of shoes and wedges. After the engine is trammed he will destroy the list of box sizes. Months after the engine has left the shop and is working at a distant terminal, some piece is broken or worn out and a replacement is required on short notice, but, because no authentic record of sizes is available, long delay ensues.

Any one who has been responsible for roundhouse operation realizes the serious delay and errors encountered in trying to transmit by telegraph sizes to cover a needed part. All too frequently in the haste to send a message, some important dimension is overlooked and the back shop is forced to ship out a piece which is only partly machined, depending on the inadequate terminal facilities to finish it ready for application. If the correct information had been received, the back shop could have machined the part ready for immediate application with only a few minutes extra time, but to do the work at the roundhouse may take hours. The roundhouse foreman will often claim that the back shop pays no attention to his requests; on the other hand, the back shop forces will criticise the roundhouse man for not sending complete information. No matter which one is at fault, repairs are held up and congestion soon adds to the already numerous duties of the foreman at the roundhouse. A system of recording important dimensions would prevent this confusion and eliminate any chance of error.

If a right front driving box is required, the general repair shops will have a complete record of all sizes necessary to prepare an exact duplicate of the box which is to be replaced. Or if it is a piston head, information is at hand so that it will require but a short time to apply it to the engine at the outside terminal.

When driving wheels are removed for general repairs, the journals, crank pins and wheel hubs are calipered to determine if they are worn or out of round. These sizes can be recorded and sent to the office to be transcribed on the master chart and after repairs are completed the finished sizes can be added to the chart. In this way a record of both the original size and the finished size is obtained and the securing of this record has made very little additional work as the checking must be done in order to make the repairs. The data thus secured also give the dimensions required for driving boxes and rods. After the driving boxes are completed and the figures showing hub faces and bore are sent to the office, it is possible to record on the master chart all information pertaining to driving boxes and side rods.

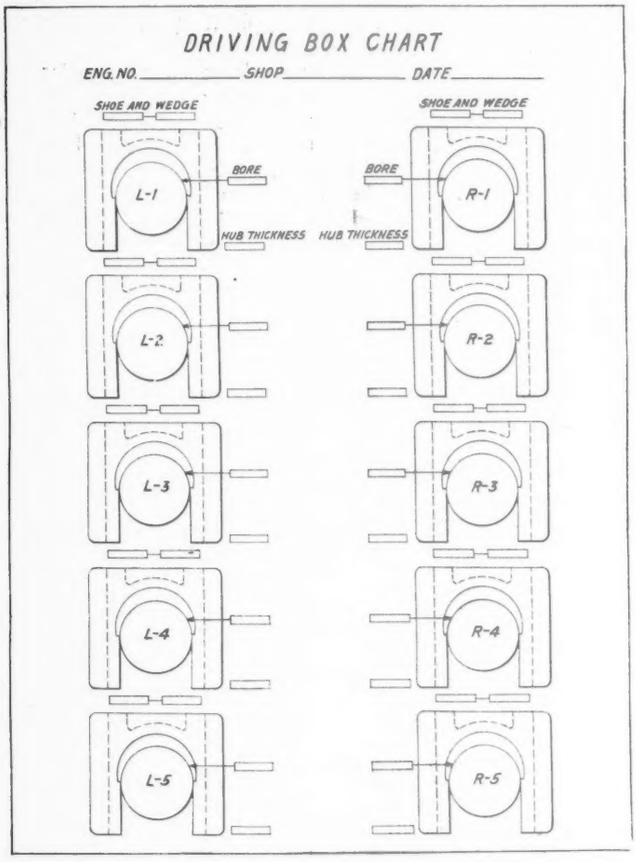


Typical Chart for Wheel Measurements

Records Are Valuable In Emergency

There are some foremen who keep book records of sizes of various parts which are handled by their departments, and for many emergency jobs these records are found in-

valuable. Thus it may be said that this record or calibration system is nothing more than the gathering up and filing of valuable information that is available in every repair shop, but usually is thrown away or lost. A complete and adequate system to maintain records of essential parts can be established without adding to the duties of the supervision. Such records will not only assist in the maintenance of motive power at outside terminal points, but they will help the stores department to secure information on which to base requests for material that ordinarily requires considerable time for delivery.



Driving Box and Shoe and Wedge Chart

To simplify the recording process, charts are provided so that the terms and location of parts are identical for all shops. The information used in various departments can be assembled at the general foreman's office and tabulated on one master chart. To provide duplicate charts for the use of the shop forces, for the roundhouse or terminals, for filing in the office of the general foreman or the master mechanic and to file at the office of the mechanical superintendent, it is suggested that the charts be compiled on tracing cloth. After all measurements are filled in, blue print copies should be made and distributed.

It will be claimed that no two mechanics "feel" the same with calipers so as to record accurate dimensions. One man may caliper "heavy," while another mechanic has a "light" touch, and the difference between these two workmen's sizes will vary enough to make the record of dimensions of no value. But railway mechanics are fast coming to the use of micrometers, and micrometer measurements do not vary.

Railway work being repair work, it is practically impossible to use snap gages, but the micrometer will meet all requirements. While it is practically impossible to obtain accurate measurements with a caliper the micrometer is so finely graduated that pressure fits can be made with a fair degree of accuracy.

How the Charts Will Help

The use of these charts will enable the stores department to order material in advance, thus avoiding delays from that cause. A note forwarded to the stores department to the

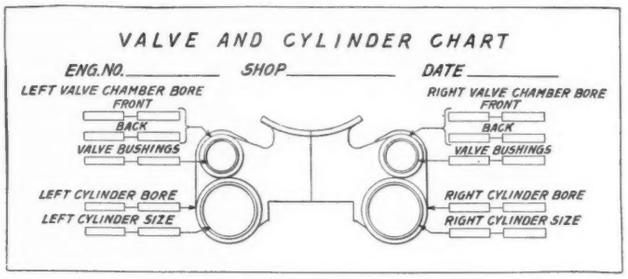


Diagram of Cylinder and Valve Dimensions

effect that certain parts had worn to the limit at the time of the last shopping gives ample time to secure new parts.

Let us analyze what this chart means to the outside terminal. A switch engine breaks a driving box. Under ordinary conditions a new box cannot be ordered until the old box is removed, so that necessary measurements can be secured. This causes delay and congestion in the roundhouse. With the calibration system in use a new box can be or-

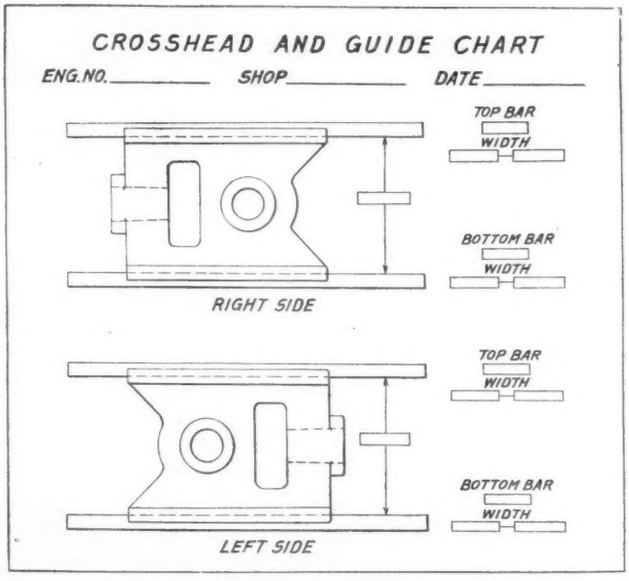


Chart for Crosshead and Guide Sizes

dered before the engine reaches the roundhouse, and by the time it is stripped the chances are that the new box will be in the shop ready for application.

Analyzing the classes of repairs which confront the outside terminal and cause the greatest amount of congestion, it will be found that they can be properly placed under five general heads as follows: (1) Pistons and valves; (2) crossheads; (3) driving boxes and wheels; (4) rods; (5) eccentrics and straps.

If every outside terminal carried a stock of material to protect these five classes of repairs, each point would have a storeroom of considerable size. As it is the general practice to carry only sufficient supplies for emergency work at outside terminals the back shop or home terminal is depended on for other requirements. Thus cylinder and valve chamber

packing is one item which usually calls for rush shipments. While it is admitted that the actual sizes of the cylinder or valve chamber should be given, it is possible to prevent the tying up of power by using rings that are the same size as those used when the engine was turned out of the shop. If, however, the chart shows the cylinder size to be 22¾ in., though the original size was 22½ in., it is evident that the cylinder has been bored and that the standard rings will not answer. If rings for a 22¾-in. cylinder are furnished and at the time of application the cylinder is found to be 22⅞ in., the master chart at the home terminal should be corrected to show this dimension.

The main dimensions for a crosshead will be the sizes of the guide bearings. But when one remembers that a crosshead will be shipped which needs attention only to the wrist pin and piston rod fits, the value of having proper guide sizes can be appreciated.

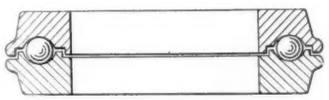
To reduce the number of charts required, driving box information can be secured from a study of the wheel chart. As side and main rods have already been standardized to a considerable extent, blue prints can be used for this item. Thus to protect these five general items of heavy roundhouse repairs, but three charts are needed. The necessary information to give correct measurements has already been secured by the back shop forces and the outside terminal receives incalculable benefit by utilizing information that the back shop usually considers of no value, and for years has thrown away. Thus a calibrating system can be organized and put into use by compiling data that is available at every repair shop.

A BALL BEARING TURNTABLE

BY G. H. BAILEY

A ball-bearing turntable, made of two old locomotive driving wheel tires for a 72-in. wheel center, is shown in the illustration. The advantages of this turntable are simplicity, low cost of construction and durability. When once installed the expense and trouble are over, as the life of a ball bearing, if it is kept well oiled, is practically unlimited.

Two old tires of 72-in. wheel center can be found about the scrap dock of almost any railroad shop and can be utilized to make this turntable without much difficulty. A 3-in. ball would be best for the bearings if the tire is not too thin



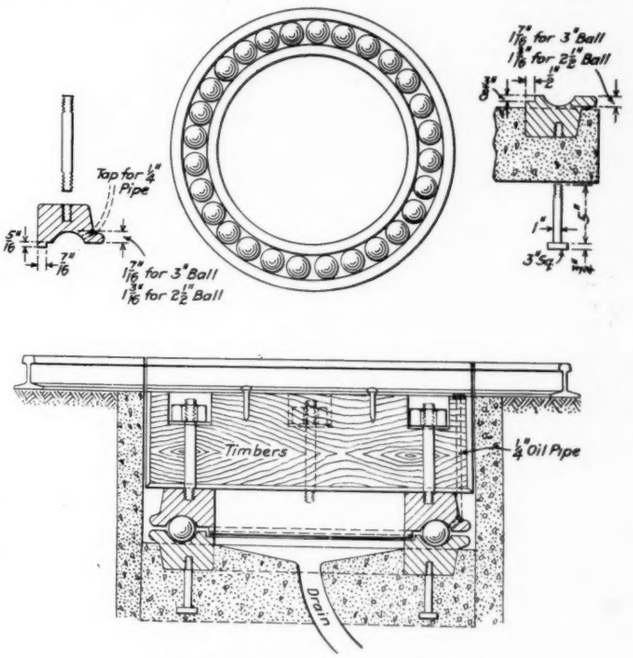
The Tires Turned With a Dust Cover

and has at least a 5-in. face to work from, as balls of this diameter are being used by many railroads for swinging rotary cranes and rotary air hoists. A ball as small as 1½ in. may be used if the tire is not thick enough to permit making a race for the 3-in. ball, the size of the ball being dependent on the tire available.

In turning or milling out this ball race a clearance of about 1/32 in. should be allowed on each side of the ball, so that friction on the balls will not be created when the turntable is in operation. When turning out this race a light cut should also be taken across the face of the tires, so that high spots will not interfere when the tires are placed together. About ⅛-in. opening must be allowed between the tires when the balls are in the race and the tires are placed in position, as the balls will wear the tool marks down somewhat, and then the tires will still clear at least 1/16 in. The tires should come close together, so that the dirt will not collect and get into the race with the balls. An offset on the tires, as shown in the drawing, takes the thrust off the balls when a heavy weight is being placed on the table. This offset should have 1/16-in. clearance, so that the tires will come in contact when a weight is being placed on the table and prevent the crushing of the balls.

A somewhat more expensive, but much more desirable, method of turning-up the tires is also shown in the drawing. In this method the upper tire is machined to overlap and project below the lower tire. This provides a cover to protect the ball bearings from the dirt that collects around the edge of the turntable.

The lower tire is embedded in concrete with six 1-in. by 5-in. bolts having a 3-in. square head and screwed into the under side of the tire to serve as stays to hold the tire firmly. The upper tire is fitted with 1-in. studs of the proper length to suit the turntable that is to be built and as many studs as



Turntable Made from Scrap Tires

may be necessary to hold the table securely to the tire. A ¼-in. pipe should be drilled and tapped into the upper tire, with the pipe running up to the top of the table, so that the bearings can be oiled with fluid oils or with a pressure gun using hard oils or grease. A cap should be provided to fit over the top of this oil pipe to exclude dirt from the bearings. The concrete bed should be arranged to provide for connection to the drainage system.

WELDING LOCOMOTIVE FRAMES

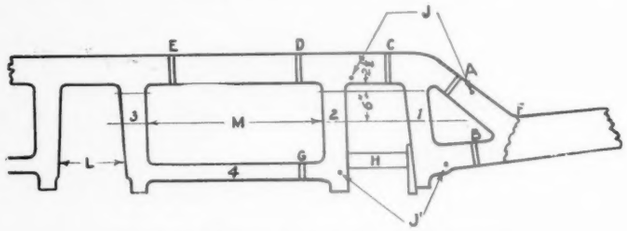
BY M. C. WHELAN

Blacksmith Foreman, St. Louis-San Francisco, Kansas City, Mo.

In thermit welding the practice of heating the lower member when the top is broken is not satisfactory, unless the lower member is kept hot until the top is cold, and in most cases by the time that the black heat contraction is taking place the lower member has been entirely cold for some time. As a result the strain on the weld is tremendous. The method described supersedes the practice of jacking up or distorting the frame to procure expansion and keeps the frame in alinement at all times. The method is not an experiment, but has been adopted and used after a thorough study of the other methods in vogue. The following instructions to be followed in connection with the sketch fully describe the procedure referred to.

When the frame is broken at *A*, the top and bottom should be trammed at *J* and *J'* and expanded by heating the pedestal

jaw at *I*, using bar and wedge *H* or jack, care being taken that the top and bottom tram marks show the same amount of expansion. After the frame at *I* is black hot, the bar *H*, or jack, may be removed, as no pressure remains. After the wax pattern and mold box are applied a fire brick furnace should be constructed so that heat will radiate around the frame jaw at the same point where the heat was applied to expand—namely, *I*. Two hours and a half after the crucible is tapped, and when contraction is started in the weld, *I* should again be heated through a hole in the furnace to a good high heat and then all holes in the furnace should be closed. The frame should then be luted with clay to retain the heat and allowed to contract to the original length while cooling at *A*. The following morning the frame should be heated again at *I* and



Welding Diagram for Locomotive Frame

at *B* to a low red heat. This will eliminate any strain which may remain from uneven cooling of *A* and *I*.

If this procedure is followed there will be no strain tending to break the frame at or near the part repaired. A glance at a broken frame in the box section will often show the enormous strain left in the frame by the fact that it is 1/32 in. to 3/32 in. apart at the break.

When a frame is broken at *B* it should be heated at the same place as if broken at *A*—namely, at *I*. It should be wedged for expansion at *B*, after which the furnace should be placed at *I* and heat applied 2½ hours after the weld is made. Heat should again be applied at *I* and *B* as a final preventive against strain. This method may be applied at any point on the frame. If the break is at *D* the frame should be heated for expansion at 2 and wedged at *H*, using the furnace at 2, and lastly heating at 2 and 4. If at *E*, it should be handled in the same way by heating at 3, using the wedge *H* at *L*, and lastly at 3 and 4.

In welding a heavy frame at *D* and *G* recently a great deal of labor was required to strip for room, so that both frames could be welded at the same time in conformity with our practice. The frame was spread at *M* for the weld at *D*, after which, by heating at 2 and wedging at *G*, the weld was made at *G* by using the furnace at 2 and finally heating at 2 and 4 (3/16 in. expansion is enough for heavy frames when using this method, as there is no pressure against the frame until the jaw is hot, after which the frame contracts naturally and uniformly). This procedure will not distort the jaw.

A number of welds have been made at *F* under the saddle, which is a difficult place and requires at least 4½ hours to heat properly in order to make a successful weld. Care must be taken to have the heating gate so set that the heat will strike directly on the heavier member of the broken parts. If the heavier part is hot the heat from that part will heat the lighter one. Expansion at this point is gained by placing a heavy rail across and through the jaws of both frames and a heavy jack placed between the saddle and this support.

When frames are broken at *C*, expansion is gained in the usual way by the use of bar *H*, as shown in sketch. Welds at *C* and *F* require about 3/32 in. more expansion than with the expansion system of heating, on account of the pressure on the weld when contraction is taking place after the wedge is out.

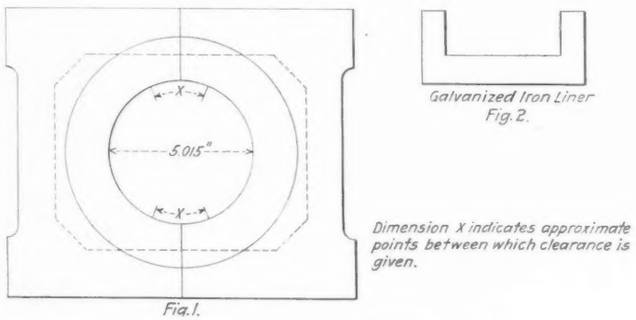
If the wax pattern and mold boxes are properly applied, the pouring gate made high enough to overcome any back pressure when the metal rises in the mold and the frame heated up to at least 1,100 deg. F. before tapping, no failures will occur where this method is followed. To obtain the temperature required for large breaks, such as 5 in. by 12 in. or over, two heating gates should be used, one on each side if possible, using a double burner preheater. On extra high welds two pouring gates or one sub-gate to assist in carrying the metal should also be used.

IMPROVED METHOD OF FITTING BRASSES

BY A. W. C.

When a main pin brass is being fitted to the pin it is a general practice to file away the portion of the brass as shown by the dimension *X* in Fig. 1 for the whole width of the brass, so that it will have no bearing on the pin at these points. It is obvious that if the brass is a tight fit in the rod (and it should be) there is a tendency for the ends of each half brass to close on the pin and cause it to warm up, a condition which is probably further aggravated as the brass gets hot. In the marine type or stub end rod (the name generally applied to a main rod of the type that has no strap but an open end), if the block is a trifle smaller than the brass, the closing together of the rod ends when the bolt is tightened will also cause the brass to pinch on the pin, so the advisability of filing this clearance is apparent.

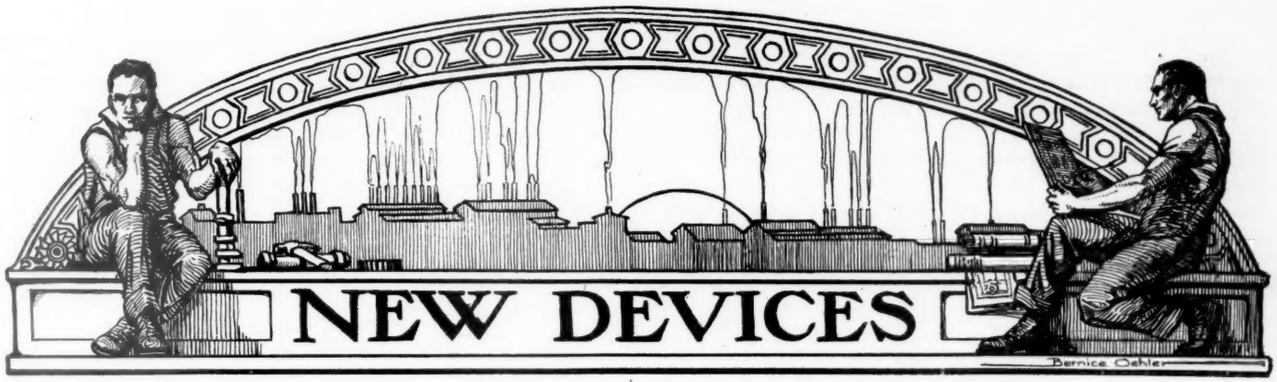
The following method of providing clearance at this part of the brass has given good results: Before the brasses are bored, galvanized iron liners about .025 in. thick, of the shape shown in Fig. 2, are placed between the half brasses, one at the top and one at the bottom. The brasses are bored out .035 in. to .040 in. larger than the pin, and it can be easily seen that when the liners are removed and the half brasses are placed together the bore of the brasses measured horizontally is from 10 to 15 thousandths larger than the pin, which is a good fit for this class of work, and when measured vertically is 35 to 40 thousandths larger than the pin, giving a very reasonable clearance at both top and bottom of brass. This method has the advantage of providing a positive, uniform clearance and eliminates all guesswork upon the part of the



Brass and Liner Used for Obtaining Clearance

workman fitting the brasses. After boring, only a small amount of scraping and spotting is necessary to complete a good fitting brass.

It is not unusual for a machinist to allow the calipers a small amount of side-play when boring a hole for a running fit to indicate that the hole is a small amount larger than the size the calipers are actually set for. If only the usual amount of side-play is given in this case, it is obvious that when the liners are removed the brass will be found bored the thickness of the liner too small, as the brasses will not butt together over the pin. If a piece of galvanized iron about 1/16 in. wide, of the same gage as the liners, is used to place one leg of the calipers on, the usual amount of side-play may be given and no difficulty in making a good fit will be experienced.

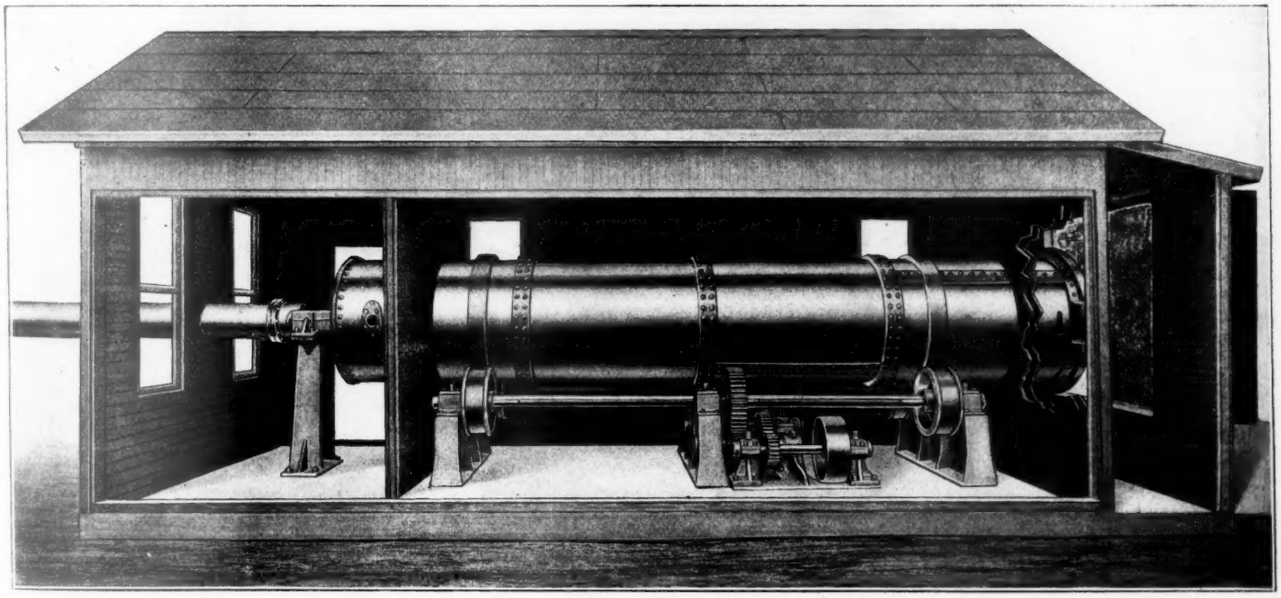


A Flue Rattler Which Cleans by Friction

A DRY flue cleaner of the revolving drum type which removes the scale by friction between the tubes instead of by impact, has been developed by the Baird Pneumatic Tool Company, Kansas City, Mo. The inside length of the rattler drum is adjustable for different lengths of tubes, so that a uniform allowance for longitudinal movement in the drum may be maintained. The cleaner is loaded through one end of the drum and the entire load of cleaned tubes is ejected in one operation.

The rattler drum has a diameter of 50 in., and is 25 ft. long inside. It has a capacity of 300 two-inch boiler tubes, 250 2¼-in. boiler tubes or 50 superheater flues. From one car, or cradle, if crane service is available, thus eliminating one handling of the tubes.

The drum is driven by a 25 hp. motor operating at 900 revolutions per minute through gears which reduce the rotation of the drum to 30 revolutions per minute. The cleaning process is simple and effective. Rattlers of the usual type depend on the shock of impact of the tubes against each other to crack and remove the scale. In the Baird rattler the tubes are not subjected to impact, but are rotated one against another. The friction of this rotation generates a large amount of heat, and the rise in temperature causes the cracking and removal of the scale. As the scale is removed



Baird Flue Cleaner

to six hours per load is required for thorough cleaning, the time depending on the nature and thickness of the scale.

One end of the drum is closed with double doors hinged at opposite sides, through which the tubes are placed in the drum. At the opposite end is placed a movable bulkhead, which is operated by the piston in a 14-in. air cylinder. For tubes requiring less than the full length of the drum, this bulkhead is moved in far enough so that the length of the cleaning chamber is but six inches longer than the tubes to be cleaned. The length of the air cylinder is such that, after the tubes have been cleaned, the bulkhead may be used to push the complete set ejected from the drum into a push

in this manner it is pulverized by the movement of the flues against each other, all moisture is expelled by the heat, and the pulverized scale, which ultimately assumes the fineness of flour, forms an effective scouring compound. The finely ground material has a tendency to rise in the revolving drum, from which it finds outlets through slotted openings near the ends of the drum. The portions of the drum containing these openings are enclosed in dust-tight rooms which prevent the scattering of the fine scale through the shop and keep it away from the gears and driving mechanism. Coming from the drum, the tubes are clean inside and out.

The first Baird rattler was installed in the shops of the

Atchison, Topeka & Santa Fe, at Topeka, Kans., over five years ago, and there are now ten installations in service on five railroads. At the time of the first installation, the new machine was confronted with an accumulation of some 200,000 dirty tubes, and for the first nine months after it was placed in service it operated 24 hours a day. Since that time it has been operated 16 hours a day. After a total operation of nearly 40,000 hours, the only cost of maintenance or loss of time was the result of an accident caused by the dropping of a bolt into the gears. The accumulation of tubes was cleaned up and the rattler has since kept up with the shop production. The service of this installation has also resulted in the elimination of warped and broken tubes, which are regular accompaniments of the use of rattlers of the impact type.

The total length of the Baird machine is 54 ft. 3 in., and its greatest width, at the base plates under the central portion of the drum, is 85 in. The base plate itself is 15 ft. 2¾ in. in length by 5 ft. 10 in. wide, and the center of the cylinder is 5 ft. 8 in. above the base plate. The overall height is 8 ft. 2 in. As is shown in the illustration, the 14-in. air cylinder for operating the movable bulkhead may be extended outside the building in which the rattler is located, thus materially reducing the amount of floor space required.

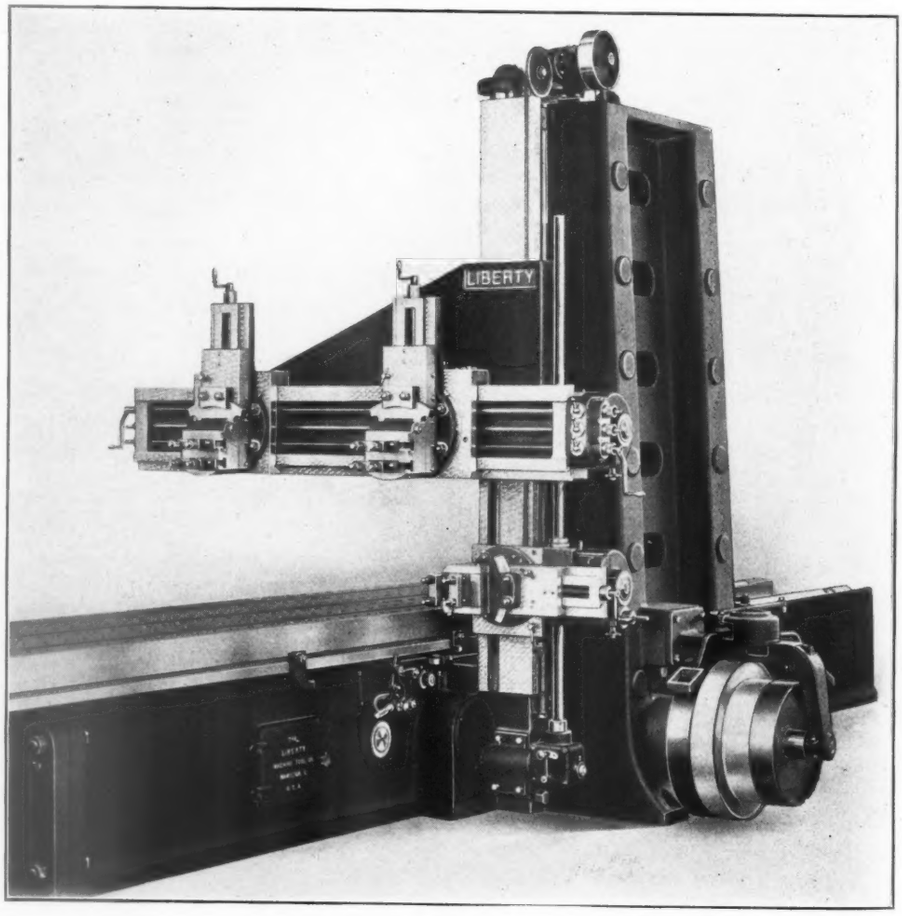
Open Side Planer for Railway Shop Use

WHILE open side planers have not been used extensively in railway shops in the past, there is no doubt but that certain planing operations can best be performed on this type of machine. For example, a deck casting 44 in. wide that had been cracked and welded, might require planing on one side. This light job could be done on a 30-in. open side planer, but would require a heavy 48-in. double housing planer to pass the casting between the housings. There is no objection to the open side planer on the ground of its lack of rigidity. Heavy cuts may be taken on an open side planer with the cutting tool and cross rail head seven feet, or even more, from the housing.

Manufactured by the Liberty Machine Tool Company, Hamilton, O., the open side planer illustrated is designed to stand the stresses peculiar to this type of machine. Due to the rigid construction of the bed, column and cross rail, it is possible to take cuts up to the capacity of modern tools. The unit system of parts makes it possible to attach any additional units after the planer is installed, and should it be desired to use the machines as a double housing, four head planer, the left-hand housing and head can be attached at any time. Ample safety appliances protect both the operator and the machine at all times.

The planer bed, extending to the floor, affords a solid foundation for the machine. The top is closed between the tracks, except through the gearing section, which is reinforced by heavy girths. The tracks are wide and V-shaped, with an ample spread to eliminate unnecessary overhang of the table. Lubrication is furnished by automatic rollers. The running gear is placed inside the bed, easily accessible from the top. All torsional strains on the shafts are relieved by pressing the gears on to the pinion hubs.

By careful design, especially of the pulleys, the shifting mechanism shifts the belts quickly and quietly and there is no accumulation of dirt on the cam and other moving parts due to the mechanism being enclosed. By means of shifting levers on both the front and rear sides of the machine, the operator can control the motion of the table without walking around the planer. A safety lock is provided to prevent accidental starting. The T-slots in the table are planed from the solid stock and reamed holes throughout the entire table length afford ample facilities for clamping. The column is of the two-faced box type construction, extending to the floor. It is bolted and doweled to the side of the bed and the wide base is arranged for bolting to the foundation.



General View of Liberty Open Side Planer

In operation, the power is transmitted from a spur gear on the end of the bull pinion shaft through a pair of reversing mitre gears to the vertical splined feed shaft. A handle conveniently located determines whether the feed is to take place on the cutting or on the return stroke. With the handle in a neutral position, all feeds are disengaged.

The amount of feed is determined by adjustable stops operated by a knob. Among the advantages of the special patented feed may be mentioned the possibility of controlling or changing the feed or rail head position at any time without stopping the machine or disturbing the feeds on other heads. Feed indicating dials enable the operator to set the feed at any required amount.

Great care was exercised to secure a rigid cross rail. It is triangular in shape, with a long and narrow guide extending upward on the front of the column. It is bolted and doweled to the triangular brace or knee which extends to the rear of the column where it is rigidly clamped by T-slot bolts in addition to a rail clamp.

Both cross rail heads are provided with long and wide bearing surfaces on the cross rail and are made right and left for close range. They are graduated for swiveling up to 90 degrees, and have automatic feeds in all directions. A great convenience to the operator results from the power elevating device located on top of the column.

The side head is mounted on the front of the column to avoid any unnecessary overhang of the tool which is brought up close to the point of support. The side head is properly counterbalanced, provided with automatic feed, and can be swiveled. The tool block is fitted with a heavy releasing spring plunger. The Liberty open side planers are made in four sizes: 30-in., 36-in., 42-in. and 48-in.

Drill Press Equipped With Electric Control

BOTH a.c. and d.c. electric control have been applied to the heavy duty drill presses shown in the illustrations and manufactured by the Colburn Machine Tool Company, Franklin, Pa. One drill press is equipped with a Cutler Hammer alternating current electric control and the other with a special direct control for reversing the spindle for tapping operations. Colburn drill presses have been arranged for reversing the spindle when provided with direct current motor drive for some time, but it is only recently that any equipment has been available which would reverse the spindle satisfactorily when alternating current motor drive was used.

The alternating current equipment (Fig. 1) consists of an

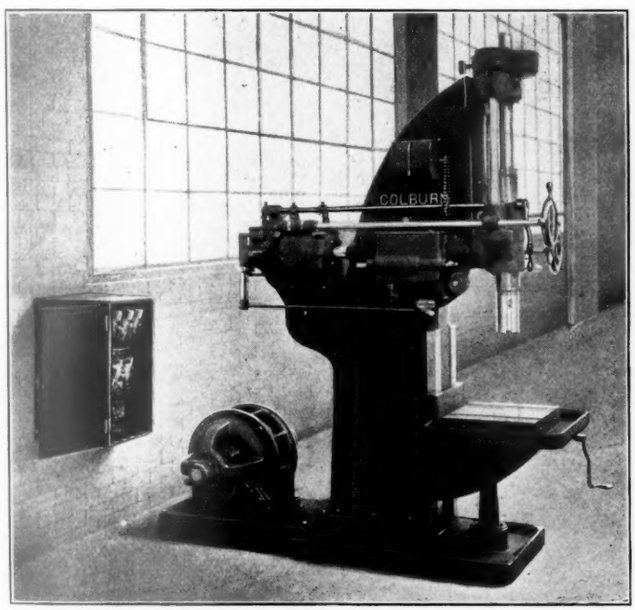


Fig. 1—Colburn Drill Press With Alternating Current Control

automatic motor starter and a reverse switch. The automatic starter is contained in a metal box which may be mounted directly on the machine or fastened to the wall as illustrated. The reverse switch is mounted on the column of the machine directly above the feed gear box, and is connected to the operating lever by sprockets and chain. It has three positions; forward, neutral and reverse.

The operator when tapping a hole, simply throws the lever to the forward position and when the tap reaches the desired depth, throws it to the extreme opposite (reverse) position which reverses the spindle instantly and withdraws the tap. To stop the machine, the lever is thrown to the neutral position.

For direct current equipment (Fig. 2) there is an automatic motor starter and reverse switch which differs somewhat in mechanical detail from the alternating current equipment. In the illustration the starter and reverse switch are shown mounted directly on the column of the machine. This reverse switch also has three positions; forward, neutral and reverse and the control is carried to the operating lever at the front by means of a lever and link.

In operation the d.c. mechanism acts similar to the a.c.. Throwing the lever to the forward position starts the spindle.

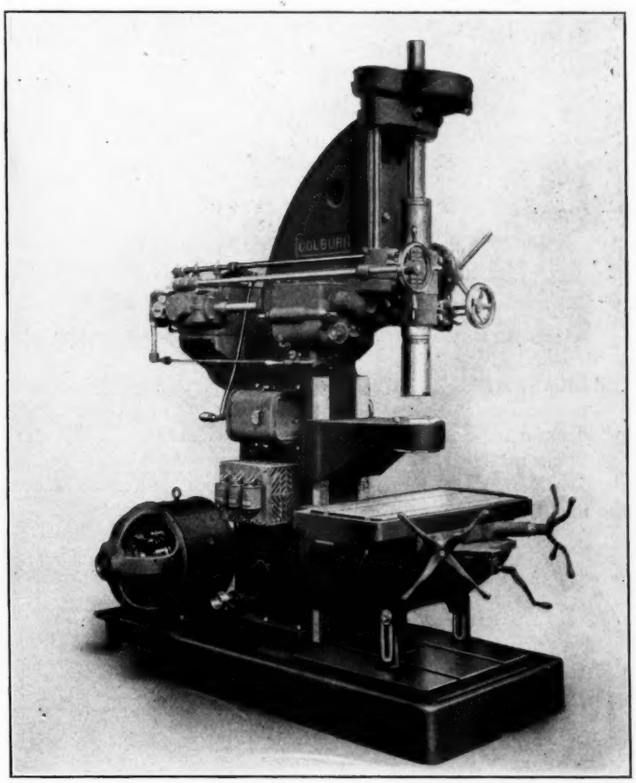
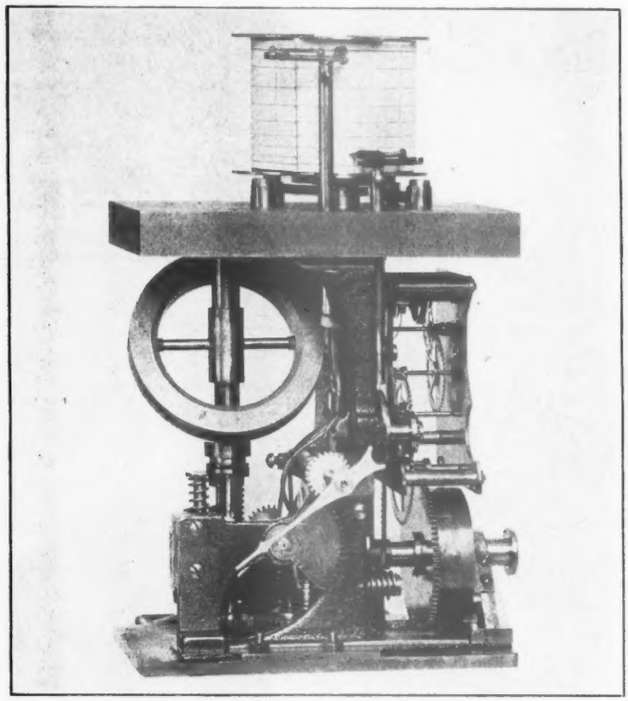


Fig. 2—Colburn Drill Press With Direct Current Control

Throwing it to the extreme opposite position reverses the spindle and throwing it to neutral, stops the spindle immediately. The illustrations show reversing a.c. and d.c. motor control as applied to the larger Colburn drill presses but either style of control is readily adaptable to the smaller sizes. The advantages of the electrical control include increased life of the machine due to a reduction in shocks and jars, and a considerable saving in taps that would otherwise be broken.

Recording Instrument for Road Locomotives

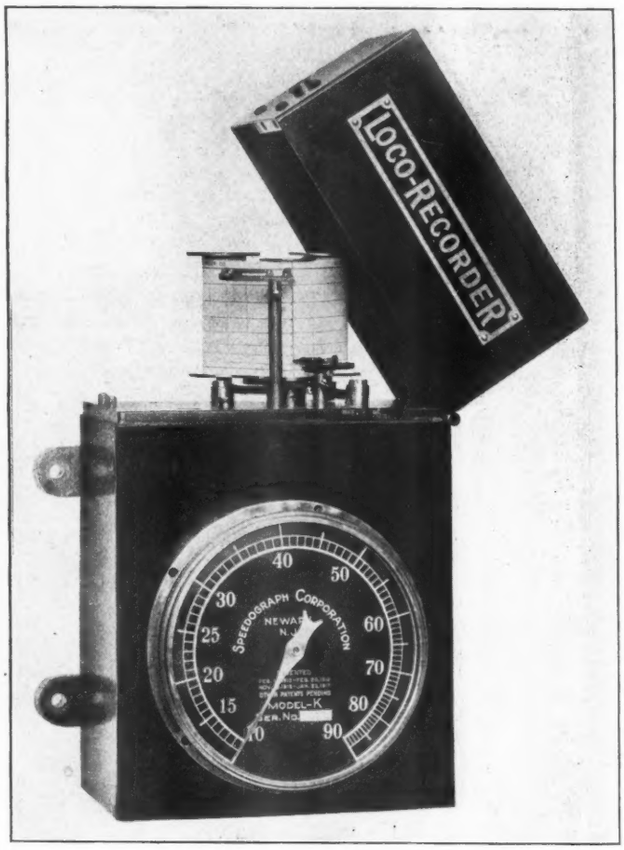
THE model *K* Loco-Recorder is a durable American-made machine, designed to indicate a locomotive's speed at all times to the engineman and give a permanent record of that speed, also the direction of motion, whether forward or back, and the time spent at station and other stops. The instrument increases the safety of train operation by practically eliminating the danger incidental to excessive speed on curves or at other points where there are speed restrictions. By furnishing an accurate record of the speed at all points there is a tendency to prevent unnecessary wear and tear on motive power, rolling stock and tracks through express train speeds of locomotives built for slow and heavy service. The need for such an instrument is especially urgent at the present time because of the increased costs of labor and material and the much larger and heavier locomotives and cars.



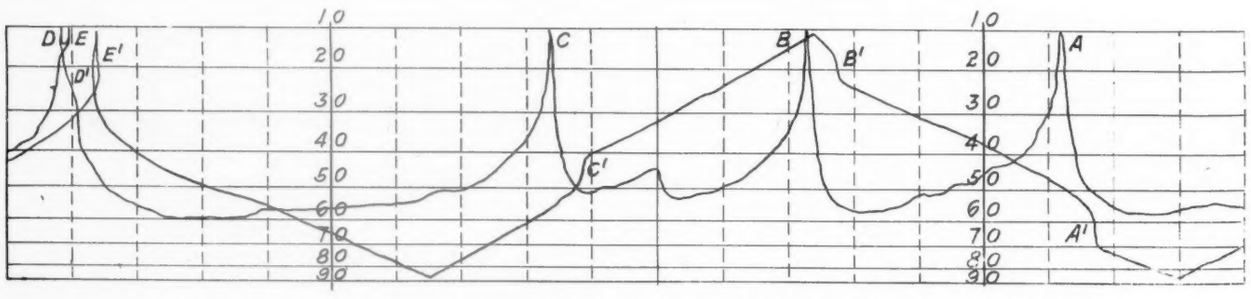
Internal Mechanism of the Speedograph Loco-Recorder

Two views of the instrument illustrates its general appearance and working mechanism, and part of a typical record made by a locomotive in regular service also is reproduced. The entire story of train operation is recorded so clearly and concisely on the strip of recording tape that it can be read at a glance. Part of the instrument is built on the plan of a speedometer, depending for its action upon centrifugal force applied to the ring shown, which actuates the indicator pointer, showing the exact speed at which it is running.

Two pencils operate independently of each other on the chart, one showing speed and the other time. The recording tape is driven by the locomotive through a connection with one of the driving wheels and moves at the rate of half an inch to the mile in keeping with the speed of the locomotive; when the locomotive stops the tape stops, and when the locomotive reverses the tape also moves backward. This makes the record easily adjustable to a keyboard, representing in the same ratio the division over which the train is operated. Stations, towers, sidings and all points at which there are speed restrictions are shown on the keyboard, together with any other desired information. By placing the record against the keyboard the speed at all points and the location and



The Recording Mechanism is Protected by the Metallic Cover Which Can Be Securely Locked



Reproduction of Part of a Record, Covering 19 Miles, Made by a Locomotive in Regular Service

duration of all stops and slowdowns are clearly shown. The tape is calibrated horizontally in miles per hour to facilitate the reading of the speed record, and perpendicularly in miles of track, with heavy lines every five miles.

The speed pencil moves across the tape in proportion to the speed of the locomotive. It returns to zero at the top of the tape at every stop, and acceleration and deceleration are plainly shown. Its action is positive and every change of speed is instantly indicated on the dial and recorded on the tape. The pencil accurately records the speed shown to the engineer on the dial; the mechanism is so interlocked that it can record nothing else. Changes of gears to compensate for the turning down of tires are furnished with each instrument to insure precise accuracy in speed indications and records.

The time pencil is actuated by a clock and moves back and forth across the tape in 10-minute strokes; 10 minutes up and 10 minutes down. When the train is in motion this pencil makes an angular line, the angle depending on the rate of speed, and when the tape stops it makes a straight vertical line, the length of which shows the duration of the stops, on the basis of 3/16 in. to a minute. This records the length of all stops up to 20 or 30 minutes in length. The dial pointer, which indicates the speed to the engineer, is the only working part of the instrument that is exposed to observation. The cover of the case completely encloses the recording mechanism and tape and is securely locked.

The record illustrated was made by a locomotive moving from the right to the left, and *A*, *B*, *C*, *D* and *E* are stops. The line connecting these points is made by the speed pencil, and shows the speed at all points and the distance covered in bringing the train to a stop and picking up speed again.

Referring to the record, *A'*, *B'*, *C'*, *D'* and *E'* are vertical lines made by the time pencil giving the length of stops at *A*, *B*, *C*, *D* and *E*, respectively. They show stops of approximately one minute at *A*, *B* and *C*. After stopping for about two minutes at *D* the train was backed, at a maximum speed of about 13 miles an hour, an eighth of a mile to *E*, where it stopped for nearly three minutes before resuming its run. It attained a speed of 57 miles an hour in three miles after leaving *A* and immediately began to slow down for *B*. The highest speed of this train, on the section of its record shown, was 60 miles an hour before reaching *D*. Midway between *B* and *C* the speed was sharply reduced from 53 to 44 miles an hour, but was immediately increased. From the foregoing it is evident that a complete, detailed record is available of train operation over the division in question.

Red E. High Speed Lathe Center

LATHE and grinding machine centers made of carbon steel often burn at the points and freeze to the work. It has long been recognized that high speed steel centers would obviate such difficulties and allow the machine to be operated at its maximum capacity, but high speed steel is expensive. It would seem poor economy to make a lathe center entirely of high speed steel when possibly less than ½ in. of the point would be used, the rest going into the scrap bin.

Lathe Center With High Speed Steel Point

The Ready Tool Company, Bridgeport, Conn., has offered one solution of the problem by making a solid lathe center with a nickel steel body and a high speed steel point. The high speed steel extends back from the point about one-quarter the length of the lathe center. On account of its solid construction, vibration is reduced to a minimum and due to the high speed steel point, the lathe center life is increased many times.

The advantages of the Red E. lathe center include not only the possibility of machine operation at a higher speed but a considerable saving in the machinist's time previously spent in grinding centers. The center is made with Morse and Jarno standard tapers, and will fit any standard make of lathe or grinding machine.

Anti-Slip Surfacing Decreases Accidents

THE hazards due to dangerous walking places are underestimated by many people, who doubtless would be surprised at the large proportion of accidents due to so apparently harmless a thing as slipping. It is difficult to get conclusive data on the subject, since casualties are often charged erroneously to other than promoting causes, yet the casualties resulting from unsafe walking are greater in number and severity than those due to any other public or industrial hazard. Based on U. S. motality statistics, the total fatalities for the continental United States were 76,500 in 1915. Of these fatalities, 14.855 were caused by falls, over half of which occurred on stairs and oor levels.

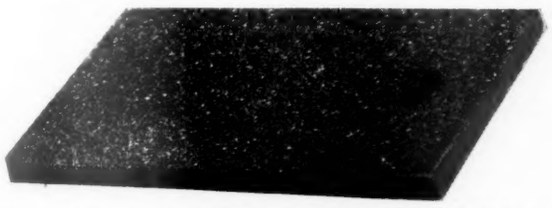


Fig. 1. View Showing the General Appearance of Vulcalum

With the above facts in mind, it is evident that too much care cannot be taken to provide safe walkways, inclines and steps in all public buildings, passenger cars and coaches. In addition, running boards and surfacing around the switch boards in power houses, where a slip may result fatally, should be surfaced with a material that will prevent slipping.

A new form of abrasive walkway surfacing called Vulcalun, has been placed on the market by the American Abrasive Metals Company, New York, and is proving satisfactory under exhaustive tests. Vulcalun is a mixture of rubber and abrasive grit vulcanized to a steel reinforcing plate contained entirely within a pure rubber base. A good idea of the general appearance of the substance is given in Fig. 1, which shows a sample piece. A cross section of the sample is shown in Fig. 2, in which *A* is the abrasive grit, *B* the perforated steel reinforcing plate and *C* the rubber base.

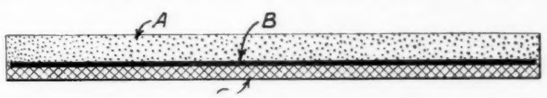


Fig. 2. Cross Section of New Abrasive Metal Surfacing

One result of the tests referred to was definite proof of the value of Vulcalun in the prevention of slipping. On a new

railway station stairway equipped with corrugated treads and subject to heavy passenger traffic, there was an average of two falls a day for a period of two months. With abrasive metal treads substituted, the succeeding two months failed to show a single fall.

Owing to the abrasive rubber surface and steel plate Vulcalun resists wear and will not crack under severe vibration. The material is adapted not only to walkways and coach steps, but due to a high dielectric strength, is desirable for surfacing around switchboards in power houses. Tests have shown that there was no electric leakage through the material up to 7,500 volts and the flashover did not occur under 20,000 volts.

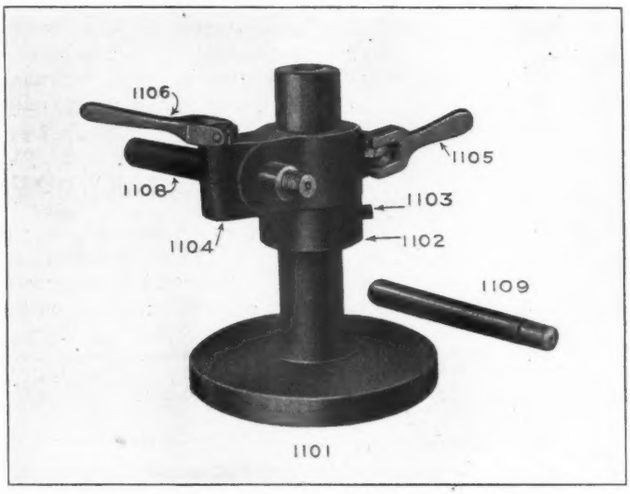
Vulcalun is light in weight, above 3½ lb. per sq. ft., and therefore is desirable for elevator car floors in freight houses and shops. Due to being enveloped entirely in a rubber base the steel reinforcing plate does not corrode; there is no tendency to disintegrate when saturated and exposed to freezing. The material is uniform in finish and manufacture, easily kept clean, and easy to renew when necessary.

Universal Vise for Pneumatic Drills

THE purpose of the repair vise illustrated is to firmly clamp and hold a pneumatic drill in various accessible positions while making necessary repairs, assembling or testing. The vise should be placed near the repairman's regular bench vise preferably on the right hand side. This arrangement leaves the regular bench vise free to be used should occasion arise. In general the drill may be clamped in any of three positions which may be most convenient for removing the gear case, spindle and valve gear; removing the valves, exhaust caps and feed screw; or for reaming piston holes or general inspection.

As shown in the illustration, the repair vise consists of a flanged upright machine post or stand *1101*, a sliding stop collar *1102* held by a suitable set screw *1103*, and a clamp *1104* which is securely held in any position on the post by tightening the quick action clamp screw *1105*. At the other end of the clamp there is a hole in which stem *1108* is engaged. This stem is threaded at one end with ½-in. and ¾-in. pipe threads respectively. For the small sized drill, a clamp with a ⅛-in. pipe thread is used in connection with a special clamp support.

Pneumatic drills are used very extensively in railway shops and the question of keeping them in repair is always a pressing one. The universal repair vise illustrated will facilitate in making quick repairs and for this reason is of interest to railway men. The vise is made by the Independent Pneumatic Tool Company, Chicago, Ill.



Thor Assembling and Repair Vise for Holding Pneumatic Drills

Car Hauling Winch Reduces Switcher Work

A NEW type of electric car hauling winch recently developed by the Shepard Electric Crane & Hoist Company, Montour, N. Y., is shown in Fig. 1. The operating units of this machine embody many of the distinctive features of the Shepard electric hoist. All moving parts are fully enclosed, making the machine entirely weatherproof with the exception of the motor. Oil bath lubrication is provided for all the gearing, brakes, etc. The gearing is of the balanced drive type, driving at two diametrically opposite points. This insures long life, high efficiency and a practically noiseless drive.

The winch is mounted on a cast base which encloses the controller resistance. A standard Shepard controller is used which may be mounted directly on the base or separately for remote control. When desired, the machine can be furnished with a gear shift, giving a reduction of four to one. This

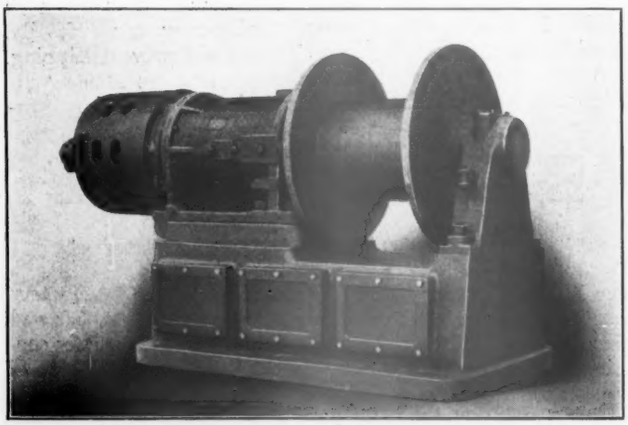


Fig. 1. Shepard Electric Car Hauling Winch

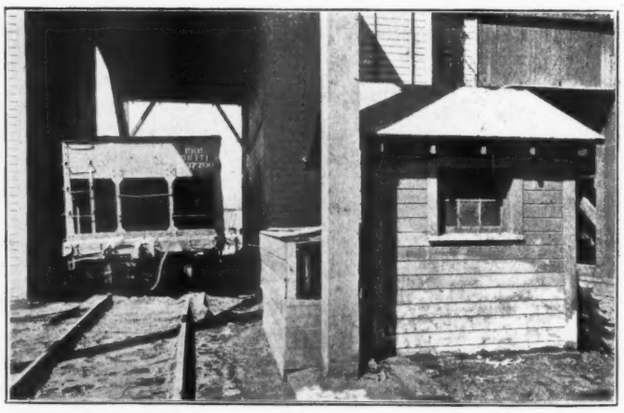


Fig. 2. Car Hauling Winch Installed at Coaling Station

enables the winch to handle four times its normal, rated load.

A recent installation of this winch in the new coaling station of the New York Central at Rensselaer is shown in Fig. 2. It is used in place of locomotives to draw loaded coal cars up to the coal dump. The winch capacity is 4½ tons at a speed of 55 ft. per min. and the winding drum has a capacity of 250 ft. of cable. Alternating current is furnished through a 22-hp., three-phase General Electric motor. Two hundred feet of ⅞-in. wire rope are used. The machine is installed in a winch house as shown with the drum extending outside.

In a test made of the Shepard car hauling winch recently, 14 coal cars were pulled around a curve and up a grade after being partly frozen in. The winch is reported to have withstood all tests of winter weather with gratifying results.

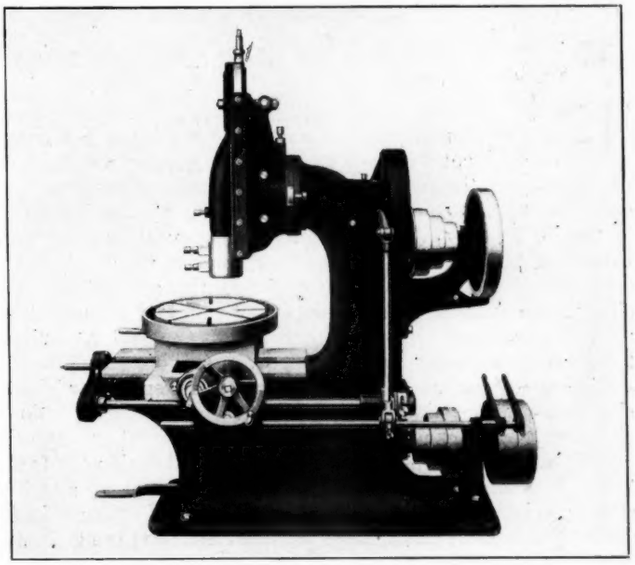
Slotting Machine for Tool Room Work

THE slotting machine illustrated has a 6½-in. stroke and on account of its general adaptability and the arrangement for swiveling the ram, the machine is well adapted for a large variety of tool room work. Taper keyways and other taper work, such as often occurs in machining dies and heavy tools can be performed without difficulty. Many machine operations on special jigs and fixtures can also be performed on this type of slotter.

The machine is cone-driven and of sufficiently rigid construction for any work within its capacity. With a proportionately heavy base and column, ample strength is insured and vibration is reduced to a minimum. Automatic feeds are provided to move both the longitudinal and transverse slides and the circular table. The table, of relatively large diameter, is graduated in degrees and has a locking device with 12 divisions. Swiveling the ram greatly increases the usefulness of the machine for all kinds of taper work and the swiveling arrangement is simple as shown in the illustration.

A universal tool holder of the clapper type is provided. All gears are mounted rigidly and the bearings are dustproof and oiltight. The countershaft is self-contained and the treadle brake shown projecting beneath the table enables the operator to stop the machine with the ram in any desired position.

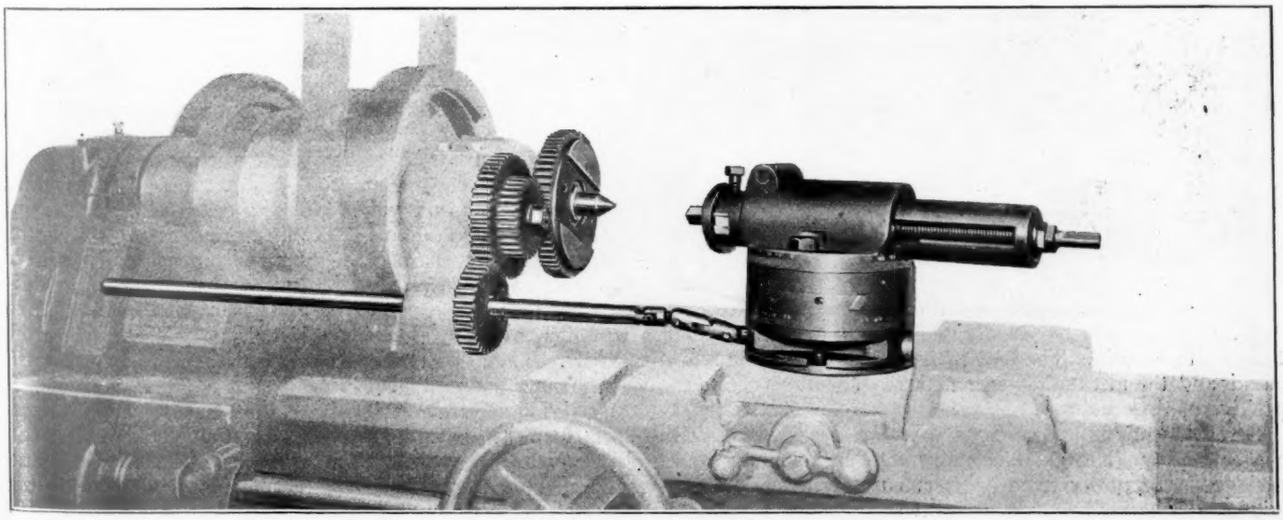
The stroke of the ram is 6½ in. and work 7½ in. high can be placed on the table. The maximum diameter of work that can be machined is 30 in. but the effective diameter of the rotary table is 16 in. The longitudinal and transverse travels are 12 in. each, and the speed ranges from 26 to 77 strokes per minute. The machine is manufactured by Harry F. Atkins, Peterborough, England, and is being placed on the American market by Alfred Herbert, Ltd., New York.



Atkins Slotting Machine With 6½ in Stroke

Fullswing Relieving Attachment for Lathes

SEVERAL new features have been included in the heavy duty relieving attachment illustrated, by means of which it is possible to perform a class of work not usually attempted on this type of lathe attachment. Interior relieving work may be mentioned as an example and in addition, all kinds of outside relieving work, including any angle, side, face, interior or irregular face flutings and taper cutting can be performed. Designed to stand hard machine shop usage,



Relieving Attachment Designed for Accuracy Under Heavy Cuts

the Fullswing relieving attachment is made in three horizontal sections, two of which remain stationary after alinement. They can be applied to any lathe equipped with a compound rest. The sections are graduated for angles of any degree and the tool holders can be moved for any axis of motion without reference to the tool. The relieving head is mounted on the single base in place of the compound rest and is driven from the nose of the headstock by a mounted gear through a train of gears as indicated. A universal joint between the spliced shaft and the relieving head allows for movement of the cross slide.

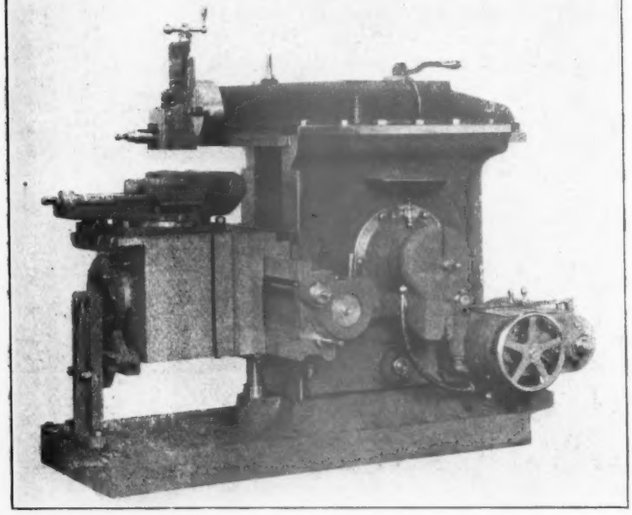
The entire mechanism is direct geared or stationary, with the exception of the reciprocating tool holder which operates in a V-guide, provided with a bronze gib. This direct connection saves lost motion and increases the accuracy and sensitiveness. A hand cross feed of three inches is provided on the tool holder for cross relieving, either straight or at an angle, thus permitting a class of work not usually attempted. Another distinctive feature is the provision in the tool holder for the vertical adjustment of the tool bit with a range of 3/8 in.

The attachment will operate in connection with the taper attachment of the lathe for relieving conical cutters and pipe reamers. Form contour cutters can be relieved when desired. A standard relief of 1/10 in. is provided, but special cams can be furnished for a greater or lesser relief. A set of four cams with one, two, three and four steps is furnished with each attachment for the operation of various flutings. A set of special gears can be furnished to relieve special formed cutters. In tool rooms and machine shops that manufacture milling and other cutters, the Fullswing relieving attachment can be used to good advantage.

Modern Refinements in Shaper Design

THERE has been a continual refinement in machine tool design in recent years to make the machines not only more efficient but adaptable to a greater variety of machine operations. The shaping machine has been no exception to this rule, and many improvements are included in the 24-in. heavy duty crank shaper manufactured by the Columbia Machine Tool Company, Hamilton, Ohio. Among these improvements may be mentioned the adaptability to either single pulley or motor drive. Additional features include a speed box, friction clutch and brake and revolving table having an outer support to provide additional stiffness.

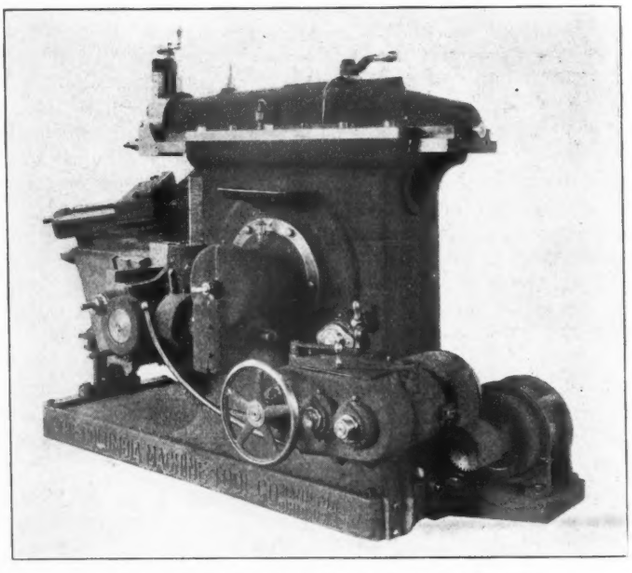
The speed box provides four changes of speed, or eight changes in connection with the back gears. The friction clutch and brake enables the machine to be started or stopped quickly at any point of the stroke. By special design the feed box is included as part of the machine and not as an attachment, and the arrangement provides a rigid and efficient feed device. Twelve feed changes are provided, ranging from



Columbia 24-In. Shaper With Modern Improvements

1/54 in. to 3/16 in. The feed takes places only on the return stroke and the mechanism automatically adjusts itself to the position of the cross rail.

Arrangements for either motor drive or single pulley drive can be made with slight alterations. In case a motor drive is desired, the power from a direct current motor is transmitted to the speed box through a rawhide gear, as illustrated. With the single-pulley drive arrangement, the main shaft of the speed box is simply extended through an additional bracket on the other side of the shaper. This allows the single pulley to be mounted on the outside and driven from the line shaft. The advantage of a friction brake in stopping the shaper in any desired position of the ram is self-evident.



View Showing Adaptability to Motor Drive

Important advantages in the crank gear construction are its liberal proportions and the fact that it is carried close to the rocker arm, thus reducing tortional strain to a minimum. The rocker arm also is of heavy construction, the sides being joined by a strong central tie. It is connected to the ram through a heavy link, which affords a direct pull on the ram.

The revolving table is plainly illustrated, and a noteworthy feature is the construction of the outer support which stiffens the table and maintains the alinement of the faces. In addition to the outer support, the table is carried on a hub, or trunnion, of large diameter, which is bolted securely to the saddle. The table rotates on this trunnion and is graduated at the outer end so that it can be set at any desired angle. A rugged double screw vise with graduated swivel base is regularly furnished with the machine, but a single screw vise can be furnished if desired. The vise jaws are steel faced and suitable clamp screws prevent the movable jaw from lifting. On the double screw vise the jaws are offset to facilitate holding work alongside the table, if required.

Railway Mechanical Engineer

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WE GUARANTEE, that of this issue, 12,350 copies were printed; that of these 12,350 copies, 11,423 were mailed to regular paid subscribers, 10 were provided for counter and news company sales, 229 were mailed to advertisers, 32 were mailed to employees and correspondents, and 656 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 61,150, an average of 12,230 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

The Texas & Pacific machine shop at Big Springs, Tex., is reported to have been destroyed by fire on March 29. Steps will be taken at once to rebuild the shops on a larger scale.

The Canadian Pacific has offered, subject to competitive examination, a free scholarship covering four years' tuition in either architecture, chemistry, civil, mechanical or electrical engineering at McGill University, Montreal, to apprentices and other employees enrolled on the company's permanent staff under 21 years of age and to sons of employees under 21 years of age.

It is reported that plans for largely increasing the number of workmen employed at the Americus, Ga., shops of the Seaboard Air Line are under consideration by officers of the company. The only other shops of the system are located in large cities and the belief that labor difficulties are less likely to occur in small industrial centers is said to be the reason for rehabilitating the Americus shops.

D. B. Hanna, president of the Canadian National, is preparing to lay before the Canadian Parliament an extensive program for increased efficiency and betterment of equipment of the Canadian National. Complete details will not be made public until the matter is laid before the Parliament at the coming session. Beyond stating that there would be no curtailment of last year's appropriations, Mr. Hanna has declined to make any further statement.

The following railroads have ordered a total of 87 of the total of 200 Decapod locomotives originally built for the Russian government, which the War Department has been trying to sell: Western Maryland, 10; Detroit, Toledo & Ironton, 15; St. Louis-San Francisco, 10; Atlantic Coast Line, 10; Charleston & Western Carolina, 3; Norfolk Southern, 4; John Ringling, 5; Seaboard Air Line, 20; St. Louis, Brownsville & Mexico, 5, and Nashville, Chattanooga & St. Louis, 5.

Domestic orders for locomotives up to the third week in March totaled 635, as compared with 1,048 in 1917, 926 in 1916, and 174 in 1915. This means, of course, that the volume of business this year, from the standpoint of number of locomotives ordered, has not been as great as in 1917 or 1916. It can also be taken to mean, in view of the underlying conditions, that the difference in volume as between this year and the two years, 1916 and 1917, has still to be made up and may eventually be added to the totals for the present year.

American Machine Tools in the Dutch East Indies

American machine tools are rapidly gaining an enviable reputation in this market, writes Consul Harry Campbell, Soerabaya, Java. One of the largest and most successful machine shops in Soerabaya is completely equipped with modern American machine tools and is securing an abundance of orders for shopwork which, it appears, it is able to fill more satisfactorily than any of its competitors. It is announced that this concern has recently been awarded the contract for the iron and steel work of a new government railway terminal at Tandjong Priok, the port of Batavia. This speaks well for the Soerabaya shop, with its American equipment, in view of the competition of Batavia firms located so much nearer the work.

Plans for Use of $300,000,000 Loan Fund

Plans for the use of the $300,000,000 revolving fund, placed at the disposition of the Interstate Commerce Commission to make loans to railroads, were discussed at a conference on March 25 by a committee representing the Association of Railway Executives with Commissioners Clark, Meyer, Daniels and Eastman, Director General Hines and R. B. Leffingwell, assistant secretary of the treasury.

Among the questions discussed was as to whether most of the available sum would be used to greatest advantage if invested in terminal improvements, etc., or in equipment.

It is understood that the executives, represented by T. De Witt Cuyler, Samuel Rea, Howard Elliott, Daniel Willard, Henry Walters and Alfred P. Thom, were inclined to urge the use of the fund largely for equipment, both because of the great need for it and because equipment can be purchased for a 25 per cent initial payment, and the fund would, therefore, accomplish more than if used otherwise.

The purchase of 80,000 freight cars, 20,000 refrigerator cars, 2,000 passenger cars, and 2,000 locomotives was discussed.

The railroads' program of capital expenditures also de-

pends on how soon they can collect from the Railroad Administration for rental due. Director General Hines is expected to ask Congress soon for an appropriation of over $400,000,000, which will enable him to make further payments to the roads.

Catalogues for Mesopotamian Railways

The Department of Overseas Trade, 35 Old Queen street, S. W. 1, advises that it has received information to the effect that the superintendent of stores of the Mesopotamian railways, in order to facilitate the preparation of demands and also for his general guidance, is desirous of obtaining copies of manufacturers' catalogues dealing with all kinds of railroad equipment and machinery, including locomotives and rolling stock, standard, meter gage and narrow gage; steam and oil pumps of all descriptions; motor rail cars, machinery —workshop, repair and manufactory; heavy and light tools as used on railways; lights, piping and fittings; general hardware; cranes; general electrical plant and accessories; engines —stationary and portable, steam and oil; conveyors, elevators, etc.; labor-saving devices generally. The catalogues should be forwarded directly to the superintendent of stores, Mesopotamian Railways, Makinah, Mesopotamia.

Italy Looking to Germany for Locomotives

Italy, which during the past two or three years has placed large orders for locomotives in the United States, is now looking to Germany as a source of supply. The reason for this, as explained in Commerce Reports in a communication from Alfred P. Dennis, commercial attaché at Rome, is the low purchasing power of the Italian lira in the American market. "It is a question," says Mr. Dennis, "how soon Germany will be able to satisfy any foreign demands of this sort, however. At the conclusion of the war that country possessed between 12,000 and 13,000 locomotives, 4,000 of which the allies took under the terms of the peace settlement; so that today Germany stands in more acute need of locomotives than does Italy. The situation in Italy is such that for the time it must continue to purchase from foreign sources, and until Germany is prepared to supply the demand the United States must be relied upon, in spite of unfavorable exchange, for whatever locomotives are imperatively needed."

Use of Air Brakes on Swedish Railways

Some few months ago, writes Consul General D. I. Murphy, Stockholm, the Swedish State Railways began to equip their rolling stock with Kunze-Knorr air brakes, a German invention. By the end of this year it is expected that 60 locomotives and 1,000 cars will be equipped with them. A project is before the Riksdag to grant an increased appropriation so that all the rolling stock of the State Railways, consisting of 1,100 locomotives, 2,500 passenger cars, and about 27,000 freight cars, may be provided with this particular brake.

The Swedish newspapers express gratification that the Kunze-Knorr brakes are to be manufactured by Aktiebolaget Nordiska Armaturfabrikerna, at Lund, that company having purchased the manufacturing rights for Sweden, Norway, and Denmark. The private railways in Sweden have been undecided as to the adoption of the air brake system, but the papers announce that there is no longer any doubt as to its adoption.

Division of Purchases Discontinued

The Division of Purchases of the United States Railroad Administration was discontinued on April 1. Henry B. Spencer, director of the division, who has been elected president of the Fruit Growers' Express Company, will become an advisory member of the director general's staff with respect to matters growing out of purchases during the period of federal control of railroads. Such portions of the work of the Division of Purchases as remained to be completed after April 1, with the exception of the completion of activities incident to control over the distribution of coal, are under the direction of the Division of Liquidation of Claims; Max Thelen, director.

Control over the distribution of coal, growing out of the strike of bituminous coal miners, was ended on April 1, in accordance with an executive order of the President. Work remaining to be done in connection with the winding-up of the matters relating thereto is being dealt with in the director general's office, through Brice Claggett, assistant to the director general.

Italy to Use Liquid Fuel for Railway Locomotives

An article in the London Times Trade Supplement says that in consequence of the scarcity and high cost of coal, the Italian Minister of Railways has ordered the immediate remodeling of 100 locomotives for use with liquid fuel. If the results are satisfactory, a further 200 locomotives will be adapted.

In Verona and Florence trials are being made with oil and coal mixed, and in Naples with oil only. Fourteen locomotives have been remodeled and are in use between Brindisi and Bari. All tests made hitherto have been very satisfactory.

The use of liquid fuel on a large scale is the only means of replacing coal quickly, as the electrification of railways can only be carried out in the course of some years. The Italian experiment must be regarded as an attempt to cope with one of the most important economic problems of the immediate future.

MEETINGS AND CONVENTIONS

Pacific Railway Club.—At its annual meeting held in San Francisco, Cal., on March 16, the Pacific Railway Club elected the following officers for the ensuing year: President, Dennistoun Wood, assistant mechanical engineer and engineer of tests, Southern Pacific; first vice-president, G. H. Harris, general superintendent, San Francisco—Oakland Terminal; second vice-president, F. S. Foote, Jr., professor of railroad engineering, University of California; treasurer, G. H. Baker, assistant general freight agent, Atchison, Topeka & Santa Fe; secretary, William S. Wollner, general safety and welfare agent, Northwestern Pacific.

National Machine Tool Builders' Association.—The annual convention of this association, of which Albert E. Newton, vice-president and general manager of the Reed-Prentice Company, Worcester, Mass., is the president, will be held at Atlantic City on May 20 and 21. At the same time the American Supply & Machinery Dealers' Association, the Southern Supply and Machinery Dealers' Association and the National Supply and Machinery Dealers' Association will also meet at Atlantic City. Many machinery manufacturers and dealers from all over the country will be represented.

American Foundrymen's Association.—A new department to be known as the Non-Ferrous Casting Section, will be added to the program of the next annual meeting of the American Foundrymen's Association, which will be held in Columbus, Ohio, on October 4 to 8, inclusive. At the meetings of this section papers and discussions of interest to practical brass and aluminum foundrymen will be presented. It is proposed to hold joint sessions also with the Institute of Metals Division of the American Institute of Mining & Metallurgical Engineers, which will hold its convention in Columbus during the same week. The other sections that will

be represented on the program of the American Foundrymen's Association are the Gray Iron, Steel Foundry, Malleable Iron and Industrial Relation Sections, and in conjunction with these meetings will be held the usual exhibit of foundry and machine shop tools, equipment and supplies.

Exhibit at Atlantic City

The exhibit at Atlantic City during the conventions of Section III—Mechanical, and Section VI—Purchases and Stores, American Railroad Association, will be a record-breaker in all respects. Arrangements are being made to place exhibits in the balcony of the main building, thus increasing the total square feet of exhibit space from 93,499 in 1919 to 99,817 ft. this year. Space has been allotted to 335 exhibitors as compared to 301 last year. There are applications for at least 30,000 sq. ft. of space in excess of the total amount available; the Exhibit Committee found it necessary in many instances to cut down the amount of space allotted to some of the applicants in order to take care of a large number of exhibitors. The only way in which additional exhibitors can be taken care of will be by making some arrangement to double up with exhibitors who have already been allotted space.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Convention May 4-7. Hotel Sherman, Chicago.

AMERICAN RAILROAD ASSOCIATION, SECTION III.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Convention, June 9-16, 1920, Atlantic City, N. J.

AMERICAN RAILROAD ASSOCIATION, SECTION VI.—PURCHASES AND STORES.—J. P. Murphy, N. Y. C., Collinwood, Ohio. Convention June 14-16, 1920, Atlantic City, N. J.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—O. E. Schlink, 485 W. Fifth St., Peru, Ind. Convention June 1-4, 1920, Hotel Sherman, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, Belt Railway, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa. Annual meeting, June 21, 1920, New Monterey Hotel, Asbury Park, N. J.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

AMERICAN STEEL TREATERS' SOCIETY.—W. H. Eisenman, 154 E. Erie St., Chicago.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

CANADIAN RAILWAY CLUB.—W. A. Booth, 131 Charron St., Montreal, Que. Meetings second Tuesday in month, except June, July and August.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 North Pine Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, secretary Federal Reserve Bank Building, St. Louis, Mo. Meetings first Tuesday in month at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 95 Liberty St., New York. Meetings second Friday in January, March, May and September and second Thursday in November, Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—J. C. Keene, Decatur, Ill.

CINCINNATI RAILWAY CLUB.—H. Boutet, 101 Carew Building, Cincinnati, Ohio. Meetings second Tuesday in February, May, September and November.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, C. H. & D., Lima, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 542 W. Jackson Blvd., Chicago. Convention, May 24-27, 1920, Hotel Sherman, Chicago, Ill.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Convention Sept. 7-10, 1920, Hotel Sherman, Chicago.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York. Convention May 25-28, Curtis Hotel, Minneapolis, Minn.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Meetings second Tuesday in month, except June, July, August and September.

NEW YORK RAILROAD CLUB.—H. D. Vought, 95 Liberty St., New York. Meetings third Friday in month, except June, July and August, 29 W. 39th St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgrebe, 623 Brisbane Building, Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Meetings, second Thursday in month, alternately in San Francisco and Oakland.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Meetings, fourth Friday in month, except June, July and August, American Club House, Pittsburgh.

ST. LOUIS RAILWAY CLUB.—J. B. Frauenthal, Union Station, St. Louis, Mo. Meetings, second Friday in month, except June, July and August.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—J. M. Byrne, 916 West 78th St., Chicago. Meetings, third Monday in month, except June, July and August.

PERSONAL MENTION

GENERAL

W. A. COTTON, formerly assistant to the general mechanical superintendent of the Erie, at Meadville, Pa., has been appointed mechanical accountant, with the same headquarters.

G. S. EDMONDS, shop superintendent of the Delaware & Hudson at Colonie, N. Y., has been appointed acting superintendent of motive power, succeeding J. H. Manning, deceased.

J. E. ENNIS, corporate assistant engineer of rolling stock of the New York Central Lines, with headquarters at New York, has been appointed engineer of equipment claims, the former corporate title of engineer of rolling stock having been abolished.

ALFRED E. CALKINS, who has been appointed superintendent rolling stock of the New York Central, lines east of Buffalo, with headquarters at New York, as noted in the April issue, served as engineer rolling stock of the New York Central and the Rutland during the greater part of federal control. Mr. Calkins began railroad work on January 7, 1892, as stenographer in the transportation department of the New York Central. On March 5 of the same year he was transferred to the general office of the mechanical department. He became chief clerk in the car shop at Rochester, N. Y., on February 15, 1898. On September 1, 1899, he was again transferred to the general office of the mechanical department as assistant chief clerk of the car department and in 1903 he was promoted to chief clerk. Afterwards he was appointed assistant to the superintendent of rolling stock and on August 1, 1918, he became engineer of rolling stock, which position he retained until his recent appointment.

A. E. Calkins

C. A. GILL, superintendent maintenance of equipment of the Baltimore & Ohio, at Baltimore, Md., has been appointed superintendent motive power of the Eastern lines, with the same headquarters.

T. F. HOWLEY, superintendent locomotive operation of the Erie, with headquarters at Meadville, Pa., has been appointed special agent, with the same headquarters.

D. L. MILLS, roundhouse foreman of the Chicago & North Western, has been appointed chief draftsman of the motive power and car departments, succeeding L. P. Michael.

B. B. MILNER, engineer of motive power of the New York Central, with office at New York, has been appointed engineer of motive power and rolling stock, and will be responsible for the design and construction of new equipment (other than electric), standards for repairs, testing equipment, supplies and materials.

JOHN L. MOHUN, assistant to E. E. Adams while consulting engineer of the Union Pacific at New York, has been

appointed mechanical assistant, with headquarters at Omaha, Neb. Mr. Mohun began railroad work as an apprentice in the Altoona shops of the Pennsylvania. Afterwards he became assistant master mechanic of the Juniata shops. He was then appointed assistant engineer of motive power and master mechanic of the New Jersey division with headquarters at Jersey City, N. J. He became assistant to the consulting engineer of the Union Pacific, with headquarters in New York in 1914.

CHARLES I. HYLAND has been appointed mechanical superintendent of the Toledo Terminal with headquarters at Toledo, Ohio. He served as chief boiler inspector of the Michigan Central from January 15, 1919, until the termination of federal control. Mr. Hyland was born on November 3, 1874, at Detroit, Mich. He was graduated from the high school at Jackson, Mich., and began railroad work as an apprentice for the Michigan Central in August, 1891. He was promoted to foreman of the boiler department in July, 1906, and left railroad service in November, 1913, to become boiler expert for the Flannery Bolt Company. He returned to the Michigan Central in 1919 as chief boiler inspector with headquarters at Detroit, Mich.

C. I. Hyland

W. K. LYNN, master mechanic of the Gulf & Ship Island at Gulfport, Miss., has been appointed superintendent, with headquarters at Hattiesburg, Miss., succeeding M. D. Fohey.

L. P. MICHAEL, whose appointment as mechanical engineer of the Chicago & North Western, with headquarters at Chicago, was announced in the April *Railway Mechanical Engineer,* was graduated from Purdue University as a bachelor of science in mechanical engineering, specializing in railroad work, in 1896. He was first employed for about one year as a locomotive fireman by the Wabash and Monon Railways, later working as a special machinist helper in the shops of the Monon at Lafayette, Ind. He was then for eight years in the service of the Cleveland, Cincinnati, Chicago & St. Louis and during that time held the positions of machinist, air brake foreman, erecting foreman, enginehouse and general foreman, draftsman and inspector of shops and machinery. Since 1906 he has been with the Chicago & North Western, being employed as a draftsman until 1908, when he was promoted to the position of chief draftsman of the motive power and car departments and held this position until he was recently appointed mechanical engineer.

L. P. Michael

GEORGE C. JONES, whose appointment as general road foreman of engines of the Atlantic Coast Line, with headquarters at Florence, S. C., was announced in the April *Railway Mechanical Engineer,* was born on August 2, 1874 at Fayetteville, N. C., and was educated at Donaldson Academy, Fayetteville. He began railroad work in the shops of the Cape Fear & Yadkin Valley Railway and later acted as a fireman and engineman on that road until it was purchased by the Atlantic Coast Line. He continued as an engineman with that road until December 20, 1909, when he was promoted to the position of road foreman of engines and on March 1, 1920, to his present one as general road foreman.

G. C. Jones

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

F. P. BARNES has been appointed master mechanic of the Colorado, Wyoming & Eastern, succeeding A. D. Howard, resigned.

J. L. BUTLER, master mechanic of the Missouri Pacific at DeSoto, Mo., has been transferred to the position of master mechanic of the St. Louis (Mo.) terminals of the Missouri Pacific.

JOHN J. MULRENEY, general foreman of the North division of the Detroit & Mackinac, has been appointed master mechanic, with headquarters at East Tawas, Mich., succeeding H. T. Thomas. Mr. Mulreney was born on August 15, 1861, at Houghton, Mich., and received his education in the public schools of Jackson. Since June, 1879, he has been engaged in railroad work, having first been employed for three years in the shops of the Michigan Central at Jackson. He then went to Bay City and remained in the employ of that road until September 10, 1889, since which time he has been with the Detroit & Mackinac. In April, 1895, he was appointed general foreman of the North Division at Alpena, Mich., and acted in that capacity continuously from that time until he received his recent appointment.

J. J. Mulreney

F. G. FISHER has been appointed assistant master mechanic of the St. Louis-San Francisco at Monett, Mo., succeeding W. J. Foley, transferred.

W. J. FOLEY, assistant master mechanic of the Northern division of the St. Louis-San Francisco at Monet, Mo., has been appointed master mechanic at Enid, Okla., succeeding A. J. Devlin.

G. B. JEFFERIS has been appointed road foreman of engines of the Stockton division of the Southern Pacific, with headquarters at Tracy, Cal., succeeding W. R. Parker, transferred.

G. H. LANGTON, shop superintendent of the Virginian at Princeton, W. Va., has been appointed master mechanic, with the same headquarters, and the title of shop superintendent has been abolished.

W. R. PARKER, road foreman of engines of the Southern Pacific at Stockton, Cal., has been transferred to West Oakland, Cal., succeeding E. E. House, retired because of ill health.

W. C. ROSS, master car builder of the Copper Range, has been appointed master mechanic at Houghton, Mich., succeeding N. M. Barker, resigned to engage in other business.

CAR DEPARTMENT

JAMES REED, who has been appointed master car builder of the New York Central, fourth district (west), with headquarters at Englewood, Ill., as noted in the April issue, served from 1913 until the termination of federal control as assistant master car builder of the same road, with headquarters at Chicago. Mr. Reed was born in 1869 at Utica, N. Y. He received a public school education and began railroad work in 1888 as car repairer on the Rome, Watertown & Ogdensburg, now part of the New York Central, at Utica. In 1891 he entered the employ of the New York Central as inspector at Herkimer, N. Y., and in 1892 he was transferred to Malone, N. Y., as foreman inspector. While serving in that capacity he was stationed at Lyons, N. Y., from 1896 until 1897, and at Rochester from 1897 until 1902, when he became chief joint inspector at Buffalo.

SHOP AND ENGINEHOUSE

CHARLES P. BOND, whose appointment as foreman of the centralization plant of the Erie at Meadville, Pa., was announced in the March *Railway Mechanical Engineer*, received his education in the Carnegie Technical School, Pittsburgh, Pa. His entire railroad work has been with the Erie, he having entered the employ of that road about 17 years ago as a machinist apprentice. Two years ago he was promoted to the position of shop demonstrator, which he held at the time of his recent appointment.

A. J. DEVLIN, master mechanic of the Western division of the St. Louis-San Francisco at Enid, Okla., has been appointed shop superintendent of the North shops at Springfield, Mo., succeeding J. E. Henshaw, transferred.

F. H. JENKINS has been appointed locomotive foreman of the Canadian Pacific, with headquarters at Brownville Junction, Me.

E. P. POOLE has been appointed supervisor of shops of the Baltimore & Ohio, with headquarters at Baltimore, Md.

PURCHASING AND STOREKEEPING

L. V. GUILD has been appointed purchasing agent of the Union Pacific, succeeding G. H. Robinson, transferred.

ALONZO ROSS has been appointed superintendent of stores of the New York region of the Erie, with headquarters at Jersey City, N. J.

OBITUARY

HENRY B. BROWN, superintendent of the fuel department of the Lehigh Valley, died suddenly at his home at Bethlehem, Pa., on April 1, aged 62 years. Mr. Brown was formerly general fuel inspector of the Illinois Central.

HARRY OSBORNE, formerly works manager at the Angus shops of the Canadian Pacific, died at Montreal on March 17, 1920, aged 61.

SUPPLY TRADE NOTES

A new office has been opened by Alfred Herbert, Ltd., New York, at 31 Yonge street, Toronto, Canada, in charge of J. C. Blair.

J. F. Griffin has been appointed chief draftsman of the Locomotive Feed Water Heater Company, 30 Church street, New York.

The Chambers Valve Company, New York, has removed its office from 30 Church street to room 1017, 23 West Forty-third street.

The Bradford Draft Gear Company has removed its New York office from 30 Church street, to suite 1018, 23 West Forty-third street.

Charles C. Kilander, Chicago manager of the American Steam Gauge & Valve Manufacturing Company, Boston, Mass., died on March 18.

The Pennsylvania Tank Car Company and the Pennsylvania Tank Line have removed their New York office from 50 Church street to 25 West Forty-third street.

The Cincinnati Grinder Company is planning a two-story addition in the rear of its plant, 3233 Colerain avenue, Cincinnati, the dimensions being 107 ft. by 60 ft.

Charles A. Beider, assistant manager of sales of the National Malleable Castings Company, Cleveland, Ohio, died in that city on March 13, at the age of 35 years.

M. C. M. Hatch, formerly with the Pulverized Fuel Equipment Corporation, New York, has become associated with the Railway & Industrial Engineers, Inc., 25 Broad street, New York.

John Jeppson, one of the founders of the Norton Company, Worcester, Mass., and for many years a director and superintendent of the plant, died suddenly in Havana, Cuba, on March 26.

A. A. Roelofs, formerly special representative in the Ohio territory, of the Precision & Thread Grinder Manufacturing Company, Philadelphia, Pa., has been made manager of the Chicago office of the company.

Fred J. Passino, who for many years has represented the Independent Pneumatic Tool Company in the Southwest, has been appointed assistant manager of the Eastern division, with headquarters in New York.

Stewart H. Ford recently opened an office at 608 Mutual building, Richmond, Va., and is engaged in the railway supply business, specializing on the Rees car and journal jacks and Hisey-Wolf electric portable tools.

The Mahr Manufacturing Company, Minneapolis, Minn., is now represented in western Pennsylvania by J. L. Edwards, with an office at 498 Union Arcade building, Pittsburgh, Pa. Mr. Edwards succeeded J. S. Longnecker.

J. F. Kroske, who served as a lieutenant with the Nineteenth Engineers during the war, has taken a position in the service department of the Ingersoll-Rand Company, New York, and is connected with its Pittsburgh office.

The Morris Machine Tool Company, Cincinnati, Ohio, has bought the business of the American Metal Products Company, also of Cincinnati, manufacturer of screw-machine products, automobile starting cranks and drag links.

The Morse Chain Company, Ithaca, N. Y., has opened two additional branch offices, one at 1402 Lexington build-

ing, Baltimore, Md., in charge of E. R. Morse, and the other at 302 Harrison building, Philadelphia, Pa., in charge of M. H. Rodda.

The Hydraulic Press Manufacturing Company, Mt. Gilead, Ohio, has opened a branch office in the Mutual Life building, Buffalo, N. Y., in charge of R. K. Havlicek, who for some time has represented the company as a sales engineer, with office at Mt. Gilead.

W. W. Williams, general manager of the Reading Iron Company, Reading, Pa., has been elected vice-president in charge of sales and operation and J. M. Callen, second vice-president, has been elected vice-president in charge of purchases and distribution of materials.

The Curtain Supply Company, Chicago, has taken over the manufacture and sale of the steam and electric railway devices formerly made and sold by the Forsyth Brothers Company, Harvey, Ill., and is increasing the capacity of its plant to care for the additional business.

Joseph R. Beatty, manager of the Fairbanks Company, Boston, died recently at his home in Newtonville, Mass. He was born in Philadelphia January 27, 1863. His connection with the Fairbanks Company started in 1896 in Philadelphia, and in 1902 he went to Boston as manager there.

The Black & Decker Manufacturing Company, Towson Heights, Baltimore, Md., announces the establishment of a permanent office and showroom at 1436 South Michigan avenue, Chicago, Ill. This office will be in charge of R. G. Ames, whose territory has been extended to cover the middle West.

Leslie R. Pyle, whose election to the vice-presidency of the Locomotive Firebox Company, with headquarters at Chicago, was announced in *Railway Mechanical Engineer* for April, was born at Cleveland, Ohio, on June 7, 1880. He entered railway service on February 6, 1906, as a locomotive fireman on the Minneapolis, St. Paul & Sault Ste. Marie. On June 1, 1909, he became an engineman, and from 1912 to 1913 was traveling fireman. On May 1, 1913, he was appointed a fuel supervisor, which position he retained until July 1, 1918, when he was appointed supervisor of the Fuel Conservation Section, Division of Operation, United States Railroad Administration. This position he retained until March 1, 1920, when he was elected to the vice-presidency of the Locomotive Firebox Company.

L. R. Pyle

The Oxweld Acetylene Company, Newark, N. J., has taken over the manufacture of the Prest-O-Lite welding and cutting equipment. This apparatus, with certain refinements of design, is now being manufactured by the Oxweld Acetylene Company under the name of Eveready welding and cutting outfits.

Joseph T. Ryerson & Son, Chicago, have made an arrangement with the Camden Iron Works, Camden, N. J., to become the selling representatives of that company, which is engaged in manufacturing hydraulic tools, centrifugal pumps, cast iron pipe and fittings, gas holders and kindred products.

The Triangle Equipment Company has been organized to deal in railway and contractors' equipment of all descriptions, with headquarters in the Munsey building, Washington, D. C. The officers are W. P. Gleason, president; Richard E. Lewis, manager, both previously with the Pennsylvania Railroad, and Anderson Allyn, treasurer, formerly with the director of sales, War Department.

J. C. Little, mechanical engineer of the Chicago & North Western, with headquarters at Chicago, has resigned to enter the service of H. G. Doran & Co., Chicago representatives of the Schaefer Equipment Company, the Clark Car Company and the Mason Tanking Company, all of Pittsburgh, Pa.; Benson & Co., New York, and the Rivet Cutting Gun Company, Cincinnati, Ohio. Mr. Little was born at Dunkirk, N. Y., on August 20, 1871, and was educated at Stanford University, Palo Alto, Cal. He began railway work with the Brooks Locomotive Works, now a part of the American Locomotive Company. In March, 1903, he went to St. Paul, Minn., as a draftsman for the Northern Pacific, and later was promoted to chief draftsman. In 1904 he was appointed chief draftsman on the Louisville & Nashville, with headquarters at Louisville, Ky., retaining that position until September, 1906, when he was appointed mechanical engineer of the Chicago & North Western.

J. C. Little

The New Britain Machine Company, New Britain, Conn., announces the election of the following officers: F. G. Platt, chairman of the board of directors; H. H. Pease, president and treasurer; A. Buol, vice-president; S. T. Goss, vice-president; C. R. Hare, vice-president; R. S. Brown, Secretary; and H. E. Erwin, assistant secretary.

D. Gleisan, manager, industrial bearings division of the Hyatt Roller Bearing Company, New York, announces that its offices have been removed from 1 Madison avenue to 100 West Forty-first street, New York, where much larger headquarters have been secured for the advertising, sales and engineering department of the division.

The Thomas Spacing Machine Company, Pittsburgh, Pa., has opened an office in Philadelphia, at 57 Transportation building. G. L. Bohannon will be in charge of this office and will handle the company's entire line of equipment. He was formerly chief engineer and assistant general manager of the Youngstown Steel Car Company.

The Rickert-Shafer Company, Erie, Pa., announces the following appointments: A. A. Shafer, secretary and general manager; C. W. Howard, formerly with the General Electric Company, general sales manager; A. J. Patterson, formerly with the Crucible Steel Company, general superintendent; and George Paterson, production manager.

Charles A. Coons resigned as secretary and treasurer of the Paxton-Mitchell Company, Omaha, Neb., on April 1, to enter the railway supply business in Omaha. Mr. Coons was connected with the Paxton-Mitchell Company for the last 14 years and prior to that time was in the motive power and car department of the Union Pacific for 20 years.

The Campbell-Howard Machine Company, formerly the Sherbrooke Iron Works, Ltd., Sherbrooke, Que., has been purchased by G. L. Bourne and F. A. Schaff, respectively president and vice-president of the Locomotive Superheater Company, New York. The company's plant will be utilized partially to manufacture railway supplies for Canadian railroads.

John N. Derby, vice-president of Manning, Maxwell & Moore, Inc., New York, died at his home in Greenwich, Conn., on March 29. Mr. Derby was born 53 years ago. He was a graduate of the University of Michigan, and in 1888 organized the Hayden & Derby Manufacturing Company in the state of Michigan. About 30 years ago he became associated with Manning, Maxwell & Moore, and the Hayden & Derby Manufacturing Company was afterwards absorbed by the United Injector Company. Mr. Derby, at the time Manning, Maxwell & Moore was incorporated, was made first vice-president, director and a member of the executive committee. His special end of the business was looking after the brass department, managing the sales of the Ashcroft Manufacturing Company, the Consolidated Safety Valve Company, and the Hancock Inspirator Company, and looking after the general railroad trade covering these lines. He was the inventor of the Metropolitan injector used on steam engines and locomotives.

J. N. Derby

The Koppel Car Repair Company has been organized recently as a subsidiary of the Koppel Industrial Car & Equipment Company, Koppel, Pa. The new company has a shop located on the property of the parent organization and is turning out four repaired cars a day and has capacity for the dismantling and prepairing for repair of about 30 cars at one time.

The Hulson Grate Company, Keokuk, Iowa, has been incorporated for the purposes of manufacturing and selling engine and locomotive appliances and devices. The amount of capital stock authorized is $100,000 and the incorporators and officers include: A. W. Hulson, president; B. D. Streeter, vice-president; J. W. Hulson, secretary-treasurer; C. R. Joy, and W. M. Hogle.

N. M. Barker, master mechanic of the Copper Range Railroad, at Houghton, Mich., has resigned to become mechanical superintendent of the American Automatic Connector Company, Cleveland, Ohio. He will have supervision of the manufacturing and installation of the connector this company is placing on the market, which is designed to automatically connect steam and air hose on freight and passenger cars.

The American Steam Conveyor Corporation, Chicago, announces the appointment of the Kon-Wald Engineering Company, Mutual Life building, Buffalo, N. Y., as its representative in Buffalo and western New York. F. A. Konzelman is manager of that company. The Brooks-Fisher Company, Chandler building, Atlanta, Ga., has been appointed southeastern representative. This company was organized early last summer to carry on a business of manufacturers, agents and contractors.

C. H. Martin and Gustav Schirmer, of the Whiting Foundry Equipment Company, Harvey, Ill., after serving for several years in its estimating and sales department at the main office, have been respectively transferred to its Pittsburgh and Detroit offices, to take up the duties of sales engineers. Both men are experienced engineers and are thoroughly familiar with the design and construction of cranes and foundry equipment.

H. U. Morton, vice-president of the Dunbar Manufacturing Company, Chicago, has been elected president of that company, succeeding Thomas Dunbar, who has resigned. The Dunbar Manufacturing Company, during the period of the war, was engaged entirely on war work and received an award for distinguished service for quantity production of artillery ammunition bodies. The company has resumed the manufacture and sale of its various railway appliances and is also in position to manufacture steel doors for cars, steel pressings, stampings and drawn steel shades.

George H. Snyder has been appointed sales engineer, with headquarters at St. Paul, Minn., of the American Steel Foundries, Chicago. He entered the service of the store department of the Minneapolis, St. Paul & Sault Ste. Marie as a clerk in 1905, and was promoted to chief clerk of the same department in 1909. He remained in that position until August 1, 1911, when he was transferred to the mechanical department and served as chief clerk under T. A. Fogue, general mechanical superintendent, until his new appointment with the American Steel Foundries.

Karl J. Eklund, general manager of Mudge & Co., has been elected vice-president in charge of sales and service. In this capacity Mr. Eklund will also have charge of western sales for the Pilliod Company, Swanton, Ohio, and the Chambers, Lyle Company. Mr. Eklund was born on July 8, 1884, and entered railroad service as a blacksmith's helper in the shops of the Boston & Maine. After three years as an appentice machinist he was employed on various railroads as a journeyman machinist. In 1908 he returned to the Boston & Maine as machinist and foreman in the Keene, N. H., shops, and on March 1, 1910, he became connected with the Pilliod Company as a valve gear inspector. On February 1, 1915, he was appointed assistant to the president of the Pilliod Company, with headquarters at New York City. He occupied this position until April 1, 1917, when he was appointed assistant to the president of Mudge & Co., Chicago, and served in this capacity until his appointment as general manager on March 1, 1918.

K. J. Eklund

The properties of the Southern Locomotive Valve Gear Company, Knoxville, Tenn., have been purchased by General L. D. Tyson (former president) and associates, and reorganized as the Southern Valve Gear Company, with ample capital and facilities to take care of any and all demands for Southern valve gears and Brown power reverse gears. The officers of the new company are: General L. D. Tyson, president; Forrest W. Andrews, vice-president; William Whaley, general manager, and H. P. Strayer, secretary. The headquarters of the new company are at Knoxville.

At the annual meeting of the Pratt & Letchworth Company, Buffalo, N. Y., on March 2, changes were made in the officers of the company as follows: John C. Bradley, who for a number of years has been president of the company, was elected chairman of the board of directors; John H. Bradley, general manager, was elected president and general manager; Franklin D. Locke, vice-president, was elected first vice-president; John P. Williams, who has been manager of sales, was elected second vice-president in charge of sales, and Willis M. Edwards was re-elected secretary and treasurer.

The leather belting plant and business of the Edward R. Ladew Company, Inc., Glen Cove, N. Y., has been bought by the Graton & Knight Manufacturing Company, Worcester, Mass., oak leather tanners and makers of leather belting. The operations of the Ladew organization will be continued as heretofore by the new owners. The plant of the Ladew Company comprises 10 modern buildings, with a floor area of 14 acres, and employs more than 600 persons. The company has branches in Boston, New York, Newark, Philadelphia, Charlotte, Pittsburgh, Cleveland and Chicago and distributors in all principal cities.

Walter H. Lovekin, for the past two years assistant to the president of the Locomotive Feed Water Heater Company, New York, has been elected vice-president and treasurer. He was born in Philadelphia, Pa., and received his education at the Haverford Preparatory School, Haverford, Pa., and Princeton University. After leaving Princeton he was employed for a time by the Logan Trust Company, Philadelphia, Pa., and by the Bell Telephone Company as a traffic inspector. He subsequently joined the Philadelphia Bureau of Municipal Research as a member of the staff, and served in this capacity for two and a half years. During this time he made detailed studies and surveys of various civic problems. After leaving this work he went with the R. J. Crozier Company, Philadelphia, as a salesman, handling railway, mill and mine supplies. On June 1, 1916, when the Locomotive Feed Water Heater Company was but two and a half months old, he entered its service, a few months later being appointed assistant to the vice-president, and in December, 1917, he was appointed assistant to the president, which position he held until his recent election as vice-president and treasurer. For the past two and a half years Mr. Lovekin, in addition to his other duties, has been in charge of the company's activities in the marine field. This involved the manufacture and delivery of feed water heaters, evaporators, boiler feed pumps, distillers and oil coolers for more than 550 ships built or building for the U. S. Shipping Board, Emergency Fleet Corporation. As vice-president he will continue in charge of the marine department and will be in charge of all sales and sales matters for the company, in addition to his duties as treasurer.

W. H. Lovekin

Charles C. Phelps has recently become associated with the Uehling Instrument Company, 71 Broadway, New York, combustion engineers and manufacturers of CO_2 recording equipment and other fuel economy apparatus. Mr. Phelps is devoting most of his attention to research work in connection with the efficient combustion of fuel oil in boiler furnaces. He graduated from Stevens Institute of Technology with the degree of mechanical engineer and has since been studying power plant problems, having been for five years associated with the Ingersoll-Rand Company, New York. Mr. Phelps is an associate member of the American Society of Mechanical Engineers.

Edward Wray has associated himself with Railway Materials as managing editor, with headquarters in Chicago. Mr. Wray was formerly managing editor and publisher of the *Railway Electrical Engineer* from its first issue in 1909 to 1916, when the magazine was purchased by the Simmons-Boardman Publishing Company, publishers of the *Railway Mechanical Engineer*. Mr. Wray continued his connection with the magazine as business manager, and later became associated with the Sangamo Electric Company, Springfield, Ill., as assistant general manager. He received his education at the University of Wisconsin, graduating in 1905, and received the degree of electrical engineer in 1906, following a year of special work devoted exclusively to the investigation of all of the various systems of lighting steam railroad cars by electricity. In carrying out this work Mr. Wray had the assistance of 10 electrical students of the senior class at the university. Mr. Wray is a member of the American Institute of Electrical Engineers, associated member of the Railway Storekeepers' Association and the Association of Railway Electrical Engineers, and has been treasurer of the Railway Electrical Supply Manufacturers' Association since its organization in 1909. Railway Materials, the paper of which Mr. Wray is now managing editor, was until recently know as the Railway Storekeeper. It is published by the former Railway Storekeepers' Association, now known as Section VI Purchases and Stores, of the American Railroad Association.

E. Wray

R. Rivett, supervisor of car repairs for the United States Railroad Administration, with headquarters at Washington, D. C., resigned on March 1 to enter the service of the Oxweld Railroad Service Company, New York, as district manager, with headquarters at Chicago. Mr. Rivett was formerly connected with the Chicago, Burlington & Quincy, entering the service of that railroad in 1881, and resigning in 1902 as general car foreman. Subsequently he was appointed general car inspector for the Union Pacific. He left the service of the latter road in 1910 to become general car inspector for the Illinois Central. In 1918 he became supervisor of car repairs for the Railroad Administration.

The Metal & Thermit Corporation, New York, in order to take care of its increasing business in the New England states and in Canada, has appointed James G. McCarty manager of its Canadian branch, with headquarters at Toronto, Ont., and has transferred Robert L. Browne from its New York office to Boston, Mass., where he will have charge of all sales in the New England states. Mr. McCarty was graduated from Stevens Institute of Technology in 1906, and became affiliated with the Metal & Thermit Corpora-

tion in 1909. He has had a wide and varied experience with all phases of the Thermit process and has represented the company in many sections of the United States and Canada. Mr. Browne has been associated with the New York office since 1917.

R. T. Walsh, general sales manager of the Sullivan Machinery Company, Chicago, for the past eight years, has been appointed vice-president in charge of sales and has also been elected a director. Mr. Walsh was born in Massachusetts and received his education at Worcester Polytechnic Institute, graduating in 1900. He entered the service of the Sullivan Machinery Company at Claremont, N. H., and after several months was assigned to the western branch of the company at Denver, Col., as a salesman. In 1906 he was appointed Pacific coast manager, with headquarters at San Francisco, Cal. He was promoted to European sales manager, with headquarters at London, Eng., five years later, and in 1913 he was appointed general sales manager, which position he held until his recent promotion.

Locomotive Stoker Company

A. C. Deverell has resigned as superintendent of motive power of the Great Northern, at St. Paul, Minn., to become western sales manager of the Locomotive Stoker Company, Pittsburgh, Pa., with office at Chicago. He was born in Montreal, Que., and after attending the public schools of that city began his career in the shops of the Grand Trunk at Montreal. He went west in 1895, and while performing some special work for Samuel Hill, president of the Eastern Minnesota Railway, came to the notice of the late James J. Hill, who appointed him superintendent of the freight car shops at St. Cloud, Minn. He was promoted to superintendent of the St. Paul locomotive and passenger car shops, the largest shops on the Great Northern system, employing approximately 19,000 men. He subsequently became assistant superintend of motive power and later served as superintendent of motive power until his recent appointment as western sales manager of the Locomotive Stoker Company.

H. C. Woodbridge has resigned as supervisor of the Fuel Conservation Section of the U. S. Railroad Administration to enter the service of the Locomotive Stoker Company as representative, with headquarters at Pittsburgh, Pa. He was born on October 7, 1874. He worked in the machine shops at Chatham, N. Y., and was extra fireman on the Lebanon Springs Railroad during 1891 and 1892. In 1897, he graduated as mechanical engineer from Cornell University. From June, 1897, to March, 1899, he worked as a machinist in the Minneapolis & St. Louis shops at Minneapolis, Minn. He was foreman at Albert Lea, in charge of locomotive and car work from March, 1899, to February 1903, but during the last two years of this period served as traveling fireman and extra locomotive engineman and pilot. In February, 1903, he was made traveling engineer and inspector for the American Locomotive Company, resigning in September, 1904, to take service as general foreman on the Delaware, Lackawanna & Western, at Elmira, N. Y., serving until November, 1905. He was appointed a master mechanic on the Buffalo, Rochester & Pittsburgh, in November, 1905, remaining in that position until January, 1908. From January, 1908, to August, 1909, he was occupied in special work for the superintendent of motive power, and was made special representative and assistant to general manager in August, 1909, remaining in that work until June, 1918. He was then appointed supervisor for the Allegheny region, Fuel Conservation Section, U. S. Railroad Administration, which position he recently resigned.

J. J. Byrne has been appointed district representative of the Locomotive Stoker Company, with his headquarters at new offices opened in Washington, D. C. He was born in Cincinnati, Ohio, and attended the publice schools of that city and Delaware, Ohio. He entered railroad service in 1903, in the Cleveland, Cincinnati, Chicago & St. Louis shops at Delaware, as machinist apprentice. After completing his apprenticeship, he entered the service of the New York Central Lines as machinist in the Collinwood shops. He remained in the employ of the New York Central until 1909, when he left to accept a position as mechanical expert with the Locomotive Stoker Company. In 1917 he was appointed representative with headquarters in New York, and the following year was transferred to the southern territory, with headquarters at Roanoke, Va. Later in the year he was located in Richmond, Va., in charge of the Locomotive Stoker Company's office at that place.

A. C. Deverell

W. C. Woodbridge

J. J. Bryne

The general offices of the Chicago Pneumatic Tool Company on March 31 were removed from Chicago to the Chicago Pneumatic building, a new 10-story structure erected for the exclusive use of the company, at 6 East Forty-fourth street, New York. The move was accomplished without appreciable interruption to business over the week-end. Arrangements, carefully made in advance, made possible the jump of the organization across half of the continent without interference to the normal routine of business except for a brief period. The Chicago district sales branch, previously in the Fisher building, has been moved to new quarters at 300 North Michigan boulevard. The Chicago service

SHOP EQUIPMENT NUMBER
PRICE 75 CENTS

branch, formerly at 521 South Dearborn street, has been consolidated with the sales branch, at the new address, and both departments are under the direction of J. L. Canby, district manager.

W. G. Walsh, notice of whose election as vice-president of the Galena Signal Oil Company, Franklin, Pa., with headquarters at Chicago, was announced in last month's issue, began railway service as an apprentice in the machine shops of the old Cleveland, Cincinnati, Chicago & Indianapolis, at Cleveland, Ohio. On the completion of his apprenticeship, he became a machinist on the Cincinnati, New Orleans & Texas Pacific at Somerset, Ky., and prior to 1890 was successively locomotive fireman, engineman and general mechanical instructor. In 1890 he was promoted to master mechanic of the Louisville division, with headquarters at Louisville, Ky., which position he retained until 1900, when he resigned to become mechanical expert for the Galena Signal Oil Company. In 1910 he was promoted to resident manager, with headquarters at Chicago, which position he retained until his recent election to the vice-presidency.

W. W. Frazier has recently been appointed assistant superintendent of the tube works of the Reading Iron Company, Reading, Pa. He began work as a draftsman and for four years served at the Loraine plant of the National Tube Company, both in the construction of its pipe mills and in the operating department. Later he served in an engineering capacity in the rearrangement of the pipe mills of the La Belle Iron Works and then went with the Youngstown Sheet & Tube Company, where for seven years he was first in the engineering department and later was general foreman of its tube mills. He was chief engineer of the A. M. Byers Company for one year, leaving that company to become assistant chief engineer at the government plant that was being built for the Ordnance Department by the U. S. Steel Corporation at Neville Island. When the armistice stopped work on this plant he went with the Bethlehem Steel Company, at Sparrows Point, as assistant chief engineer and recently became associated with the Reading Iron Company as assistant superintendent of its tube works.

J. S. Lemley, who for the past five years has been general sales manager of the G. F. Cotter Supply Company, Houston, Texas, has left that company to become associated with and a partner of W. D. Jenkins, Dallas, Texas, representative of manufacturers of railway equipment and supplies, with principal office at Dallas and offices also at Houston and New Orleans, La. Mr. Lemley will have full charge of all mechanical matters. He served on the Baltimore & Ohio in 1898 as a locomotive engineman and a short time later was promoted to trainmaster. After serving in this capacity for two years he went to the mechanical department of the Chicago, Milwaukee & St. Paul. Two years later he was appointed general supervisor of locomotive operation of the Baltimore & Ohio South-Western and the Cincinnati, Hamilton & Dayton, with headquarters at Cincinnati. After serving in that capacity for two years he went to the mechanical department of the Texas & Pacific, remaining with that road until July 1, 1915, when he became associated with the G. F. Cotter Supply Company. C. E. Naylor, who has been associated with Mr. Jenkins since 1916, and formerly served on the Texas & Pacific and the International & Great Northern in the mechanical and traffic departments, is in charge of the Houston office. R. L. Irwin is in charge of the New Orleans territory. Mr. Irwin was formerly purchasing agent of the Texas & Pacific, and during federal control of the railroads was purchasing agent of the lines under the jurisdiction of F. G. Pettibone as federal manager at Dallas, Tex. J. K. Bagley, formerly with the Texas & Pacific as chief clerk in the purchasing department, is in charge of the New Orleans office.

TRADE PUBLICATIONS

Union Fittings.—The E. M. Dart Manufacturing Company, Providence, R. I., has issued its 1920 catalogue (S) of unions and flanges, with illustrations, prices and schedules showing sizes, dimensions, weights, etc.

Time Zones.—The Metal & Thermit Corporation, New York, is distributing a large map and calendar for 1920, showing railroad time zones in the United States and Canada and illustrating a number of interesting repairs made with Thermit welding.

Locomotive Chart.—The Angus Sinclair Company, New York, has recently prepared a chart of a Pacific type locomotive showing a longitudinal cross section and a rear view of the interior of the cab. The detail parts are numbered and the names are given in a list printed on the sheet.

Air Compressors.—The National Compressed Air Machinery Company, San Francisco, Cal., has published a bulletin, No. 20, describing the construction of a vertical type air compressor and containing a table of dimensions and specifications of the various models built by this company.

Cranes.—The Whiting Foundry Equipment Company, Harvey, Ill., has issued a new edition of its crane catalogue, designated as catalogue No. 151, containing 80 pages, 6 in. by 9 in., with a great many illustrations. Cranes of all types are represented and detailed information is given concerning them.

Vise for Pneumatic Drills.—A four-page circular has been issued by the Independent Pneumatic Tool Company, Chicago, describing a new universal vise for pneumatic drills, the purpose of which is to firmly clamp and hold the drill in accessible positions while repairs, assembling and testing are done. Illustrations show the detail parts of the vise and how to use it.

Power Hammers. — A belt-driven and a motor-driven power hammer are described in a 16-page booklet published by Beaudry & Co., Inc., Boston, Mass. Both types are manufactured in various sizes and are described in detail, with tables showing sizes and dimensions. All the individual parts are illustrated and numbered for convenience when ordering.

Some Remarks from Dan McGann.—Under this title the Walworth Manufacturing Company, Boston, Mass., has issued a folder containing a short poem in which Dan McGann declares his adherence to the principles of Americanism in the vigorous language of the shop. The folder, which is suitable for use as a poster, has already had a wide circulation in industrial plants.

Constitution of the United States. — The Clark Equipment Company, Buchanan, Mich., has published an attractive booklet containing a reproduction of the Constitution of the United States and all amendments. It is illustrated with pen portraits of notable American Presidents by W. M. Young. This is a booklet which every American would be glad to have, and will be mailed on request.

Air Compressors.—Bulletin 75-U of the Sullivan Machinery Company, Chicago, describes in considerable detail the Sullivan tandem compound Corliss steam driven air compressors, class "WC", which are available in unit capacities of from 1,000 to 3,150 cu. ft. of free air a minute. Photographs accompanying the text show installations of the Sullivan Corliss compressors and indicate the range of service which they are performing.